The FOUNDRY

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Castings Make Easier the Tanning of Leather

METHODS of converting the skins of animals into leather were known several thousand years ago, for the tombs of the ancient Egyptians picture the tanning process and specimens of leather have been found in China, which show that the people of that nation were tanning leather 3000 years ago. However, progress in the

Skins May Be Split Into from Two to Four Thicknesses by Being Fed Against Endless Steel Knife Belts

art of tanning has been slow and the first radical change in method was not made until 1790, when lime was introduced as a method of loosening the hair. The first tannery in the United States was built in Virginia in 1630 and a few years later a second plant was established in Lynn, Mass. Since that date the industry has grown until the value of leather produced yearly now is approximately $500,000,000. During the past ten years a number of machines have been introduced which have made operations automatic or semiautomatic which formerly were accomplished manually. Among the machines which now are used may be included the shear knife for cutting the hides into sides, the fleshing machine, unhairing machine, splitting machine, staking machine and the vibrating jacking machine. Due to the heavy nature of the machines, the greater portion of the parts are the product of the foundry.

Find Where Castings Can Be Sold

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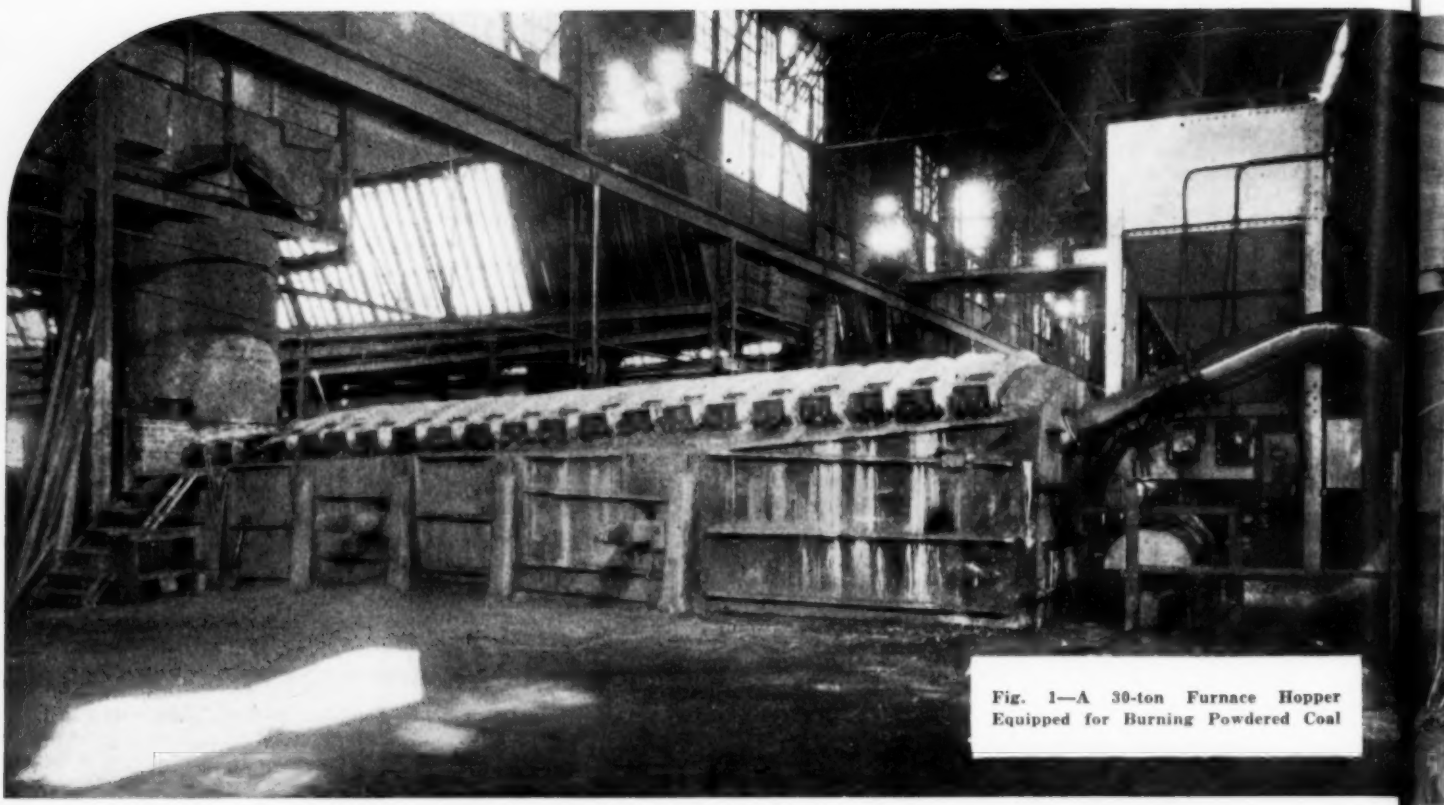


Fig. 1—A 30-ton Furnace Hopper Equipped for Burning Powdered Coal

Utilize Powdered Coal

Melting Furnaces, Annealing and Core Ovens in Michigan Plant With Increase in Capacity

INSTALLATION of elaborate equipment for the preparation, conveyance and combustion of powdered coal marks the latest stage in a consistent program of progress that has characterized the history of the Albion Malleable Iron Co., Albion, Mich., from its inception forty years ago up to the present. Originally the plant was designed and operated for the production of castings for the agricultural industry and the furnaces were hand fired with soft coal in the manner that has become familiar, a manner that for many years was accepted as standard and which still is practiced extensively in the malleable iron industry.

Beginning with the acceptance of a few orders for automotive parts when engineers first became interested in malleable iron as a source of casting supply, the business eventually expanded to a point where the manufacture of agricultural machinery castings was abandoned altogether and the entire capacity of the plant was turned over to the newer industry. At present and for some time past the company has operated one 40-ton and seven 30-ton reverberatory furnaces in melting metal to conform to the standards set up by the American Malleable Castings association and demanded by the manufacturers of automotive vehicles. The furnaces originally had a capacity of 25 and 30 tons. Removal of the firebox and bridgewall incident to the change from hand firing to the use of powdered coal resulted in an increased hearth capacity without any further change in the design or construction of each furnace.

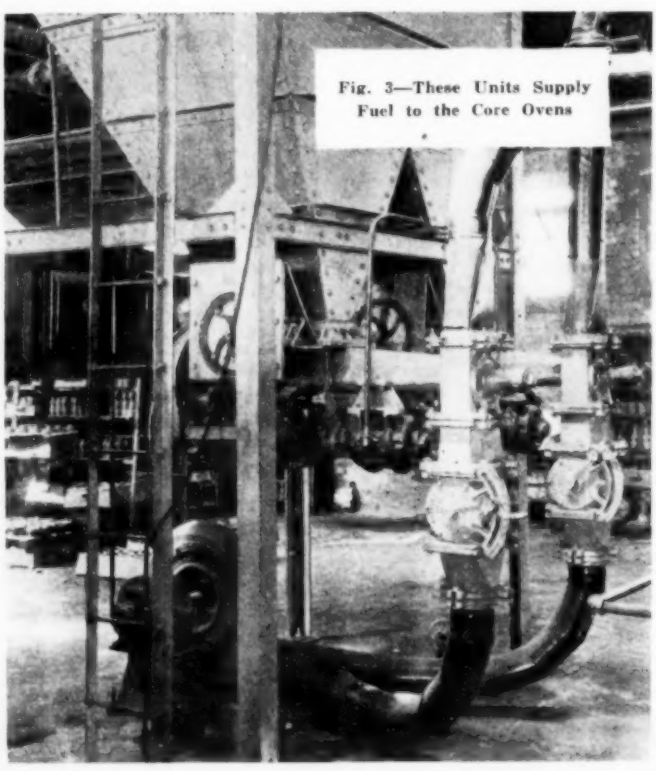


Fig. 3—These Units Supply Fuel to the Core Ovens

The main foundry building 500 feet in length is divided longitudinally into three

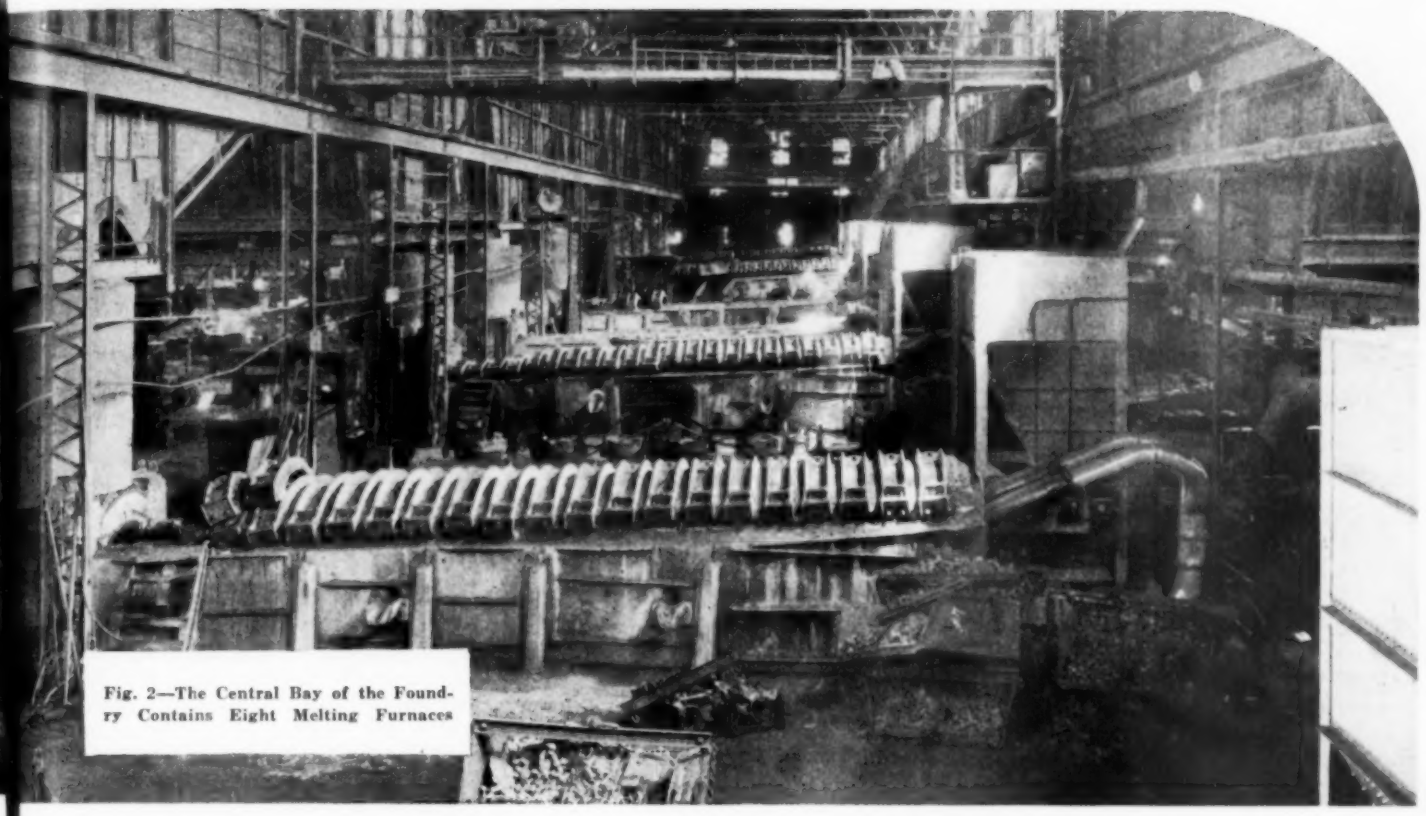


Fig. 2—The Central Bay of the Foundry Contains Eight Melting Furnaces

In Malleable Foundry

Have Been Adapted To Burning Powdered Coal and Gratifying Decrease in Operating Costs

By Pat Dwyer

bays. The center section shown in Fig. 2 contains the eight furnaces arranged symmetrically in a straight line with the firing end shown to the right and the stack to the left end of each furnace. This bay is served by two 5-ton cranes made by the Shaw Electric Crane Co., Muskegon, Mich., and is surmounted by a comparatively high monitor roof with a continuous window in each of the upright side walls. Since head room is not a factor in the two side bays which parallel the center, the roof slants upward from 15 feet high at the outside wall to 20 feet at the line where it joins the monitor over the center bay. Illumination is secured through a row of windows on the side. The molding floors extend from the side wall to a wide gangway extending the full length of the building and separating the center bay from the bay on each side.

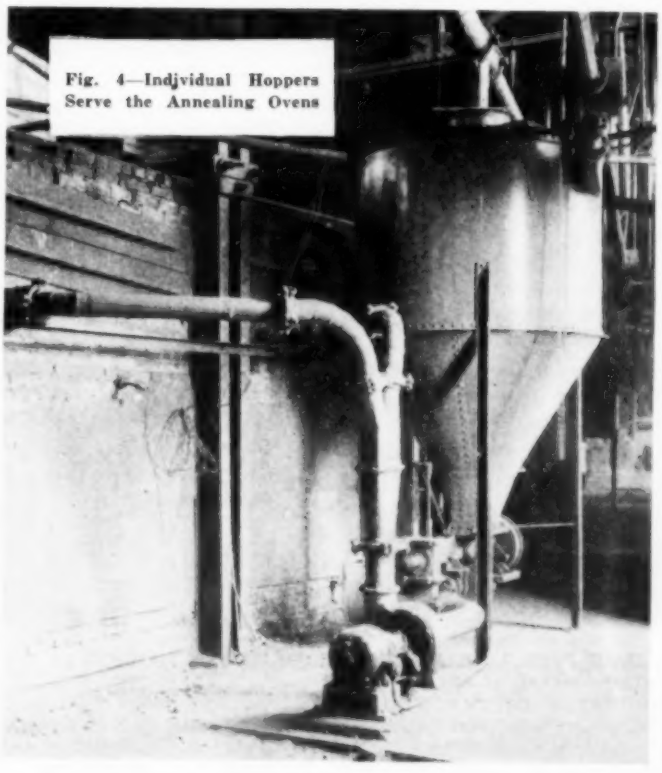


Fig. 4—Indjvidual Hoppers Serve the Annealing Ovens

Two methods of distributing iron are used. It is caught directly from the spout in hand ladles or is taken away in ladles of 1-ton capacity depending on where it is required. The large ladles are handled by one of the cranes and placed on suitable carriages mounted on a narrow gage track laid on all the gangways. An attendant follows each ladle and at its destination, fills the hand ladles of the men who pour the molds.

Each furnace is provided with two tapping spouts, one on a 6-inch higher level than the other. This system has been found advisable particularly since the furnaces have been melting a larger quantity of metal than usual as a result of the hearth extension. Difficulties sometimes experienced in getting the metal sufficiently hot at the bottom of a deep bath have been overcome by the

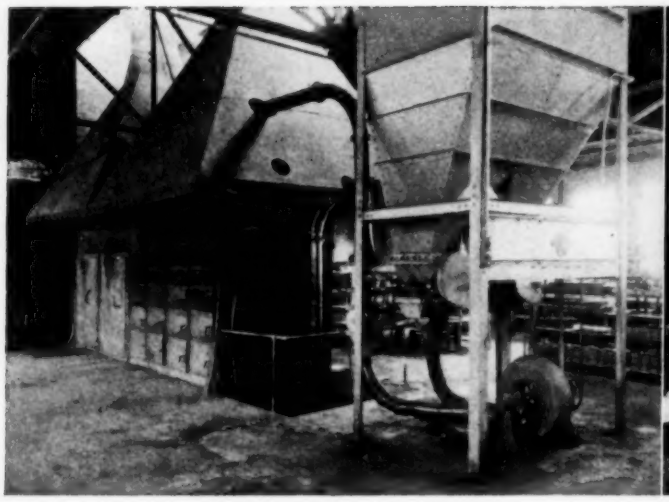


FIG. 5—A SINGLE BLOWER SERVES BOTH BATTERIES OF OVENS WITH POWDERED COAL FROM A TWIN HOPPER. FIG. 6—POWDERED COAL FUEL IS USED IN THE OVENS WHERE THE LADLES ARE DRIED

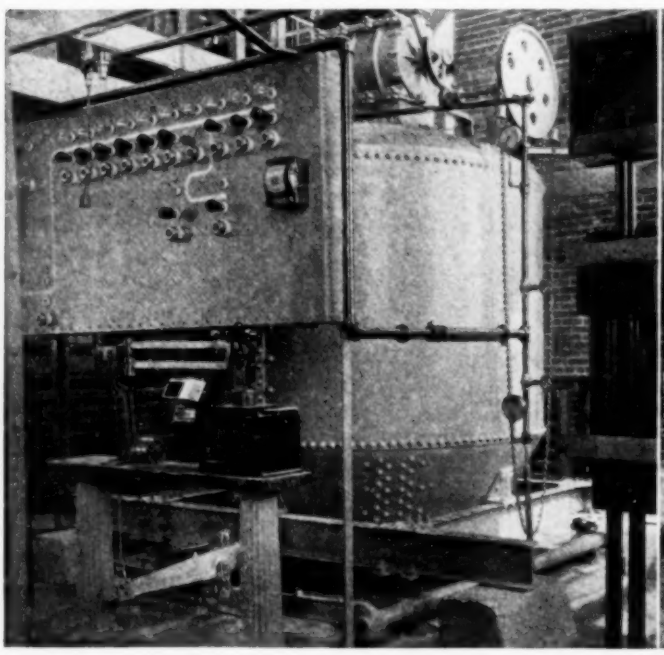
adoption of the two spouts. The hotter metal on top first is tapped through the higher spout of the two. As the depth of the bath decreases the remainder of the metal is raised to the required temperature and eventually is tapped through the lower tap hole.

Economies effected through the use of powdered fuel in the melting furnaces prompted the company to install equipment for burning the same kind of fuel in the annealing ovens as shown in Fig. 9. Finally to make the installation complete a powdered fuel burner was placed in the firebox of the coreoven battery. A second somewhat similar burner was introduced into the firebox of the oven in which the hand ladles are dried.

Among the claims advanced for the different installations are that marked fuel economies are experienced, better and more uniform distribution of the heat are effected, direct labor has been reduced to a practically negligible minimum and a better and more uniform quality has been established in the product.

The entire powdered coal system, designed and installed by the Grindle Fuel Equipment Co., Chicago, is under the control of one operator with headquarters in a building located some distance from the group of foundry buildings and containing the necessary equipment for drying, grinding, pulverizing, weighing and sending the fuel on its way to the various burners. Colored lights on a panel board keep the operator informed of every change in conditions at the furnaces and ovens. Through a system of remote control he adjusts the valves at the various stations. Danger of a mixup of any kind throughout the system thus is avoided by placing the entire sensitive record and control under the observation and in the hands of one man.

Coal from bottom dump cars is unloaded through a heavy steel grating located between the rails on a section of the railroad track close to the building in which it is to be prepared for use in a pulverized form. A steel plate conveyor set at an angle of 45 degrees from the horizontal carries the coal from the bottom of a cement lined hopper under



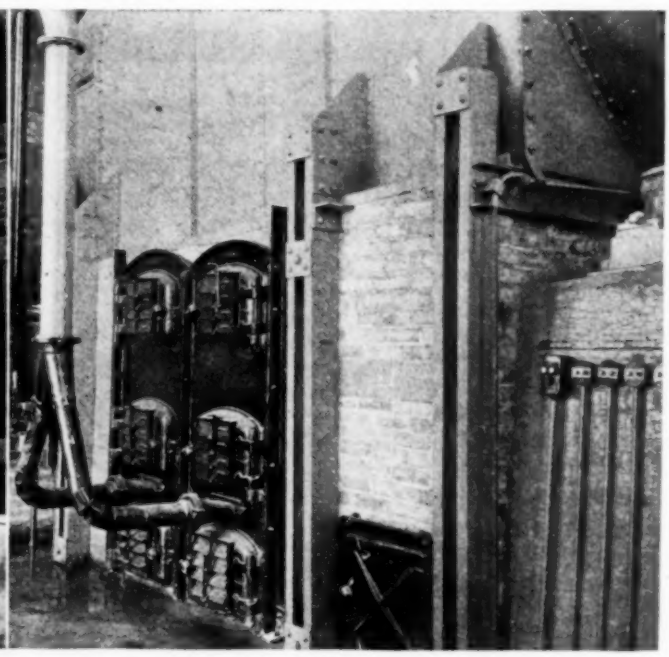


FIG. 7—BEFORE ENTERING THE MAIN FEED LINE ALL POWDERED COAL IS WEIGHED IN A TANK MOUNTED ON A SCALE. THE SIGNAL AND OPERATING CONTROL BOARD IS SHOWN AT THE UPPER LEFT. FIG. 8—PUSH BUTTON CONTROLS FOR THE MECHANICAL EQUIPMENT IN THE DRYING STATION ARE SHOWN IN THE LOWER RIGHT

the track to a point high up in the building where it passes over a magnetic pulley and thence into a crusher designed to reduce the lumps to a uniform size not over one inch.

Approximately a small barrel full of miscellaneous iron and steel parts is removed every day from the coal before it enters the crusher. The list includes bolts, coupling pins, links, picks with and without handles, lengths of chain, fish plates, horse shoes and strands of wire. Through association of circumstances an occasional workman's old shoe with iron sole and heel plates causes the spectator's mind to bring up long forgotten and weird legends of the Molly McGuires and their methods of disposing of victims in the wild and mountainous country from which most of the coal in Pennsylvania and West Virginia is extracted. Short pieces of chain or other examples of scrap that escape the magnetic pulley and pass through the crusher in a mangled form without rupturing it, suggest further reflection on the activities of the lawless bands of masked ruffians who terrorized the coal mining regions in the late seventies.

From the crusher the coal is discharged into a revolving drum partly shown in the upper part of the illustration Fig. 8. Here the water is evaporated over a fire supplied with powdered coal fuel from the main source of supply as indicated in Fig. 7. The moisture content of the coal is reduced to less than 1 per cent, a condition regarded as perfect for all practical purposes. The natural moisture content of coal would not affect its value as fuel, but it would interfere seriously with the efficacy of the grinding and pulverizing operations, also with the free passage through the various pipes connecting the pulverizing station with the burners where it ultimately is consumed. Any measure of dampness also would cause the material to cake and cling to the sides of the individual hoppers located close to each furnace and oven. In the dried form the pulverized fuel slips through the pipes as smoothly and readily and with as little friction as fuel oil flowing into a tanker.

Coal is dried in measured batches and discharged first into a grinder where it is reduced to a coarse powder and then into a mill where the powder is converted into an almost impalpable material that will pass almost completely through a 200-mesh sieve. Up to this point movement of material has been effected by plate conveyor, bucket elevator and gravity. Subsequent movement is secured through the agency of air supplied by suitable blowers and a compressor. The newly pulverized coal is sucked from the pulverizing device near the floor level and discharged through a pipe high up in the building into a large storage tank.

This tank serves as a stabilizer or practically inexhaustible source of supply from which the pulverized fuel may be taken in small or large quantities either at regular or at intermittent periods. From the upper tank the coal descends to the tank shown in Fig. 7 resting on a scale at the floor level. An automatic device on this scale records the amount of coal that passes through. The attendant at one of the furnaces or other firing points flashes a signal to supply more coal. The operator at the central station opens the intake valve at the designated station, closes all others on the line and shoots the required amount of coal to the firing station. An automatic device on each of the storage tanks near the burners indicates when the tank is nearly empty. A small compressor made by the Ingersoll-Rand Co., partly shown to the extreme right in Fig. 7, is used to drive the coal dust through the main feed line from the service building to the various points in the foundry where it is consumed.

Two main feed lines have been installed, one underground and one sufficiently high in the air between the two buildings to permit the passage of a steam crane with the boom elevated. Only one line is used at a time. The second is held in readiness as a spare in the rather improbable, but always possible event that an accident might put the first line out of commmission.

Inside the foundry the main feed line is mounted at a sufficient height to clear the top of the battery of individual tanks located close to the firing end of the furnaces and ovens as shown in the various illustrations. Passage of the coal either into the tank or further along the pipe is secured by a switching valve in the pipe close to where a connection from the pipe enters each tank. The valve closes automatically when the tank is filled and opens when it is empty. A hand chain from the valve hangs within easy reach in the event that manual operation is required. In smaller installations the individual tanks are omitted. The feed pipe for each combustion unit is connected directly to the main supply line. In this instance the units are so widely scattered and some are so far distant from the service station that the individual tanks are required to absorb fluctuations in supply and demand and thus insure uninterrupted operation at any given point.

FIG. 9—GENERAL VIEW AT THE BACK OF A BATTERY OF 12 ANNEALING OVENS WITH AN INDIVIDUAL HOPPER OR STORAGE TANK FOR EACH OVEN

In practice the man in charge of the service station opens the valves in rotation on the various tanks and fills the tanks with fuel. After the most distant tank is filled, the remaining coal in the feed pipe either is returned to the service station, or, is discharged into a tank located in the extreme end of the building containing the melting furnaces. It is removed from this tank and packed in bags as sea coal to be used for facing either in the foundry or sold to the foundry trade elsewhere. At the time this is written a change is

(*Concluded on Page* 673)

Northwest Offers Field for *Synthetic Cast Iron-I*

By G. A Schaller

RAPID strides made by the electric furnace in this country may be traced to two major causes. First, early experiments and developments were backed by powerful influences. The second major cause which gave the electric furnace an impetus it would not have received in any other way was the World war and its subsequent insatiable demand on the iron and steel industry for ordnance material in addition to the standard range of iron and steel products. The former demand was difficult to fill because of the stringent specifications for excellent physical quality necessary to meet ordnance requirements. The question of minimum weight coupled with maximum strength was paramount and called for new methods and new processes for production undreamed of before.

Application of the electric furnace to the manufacture of synthetic iron had its greatest growth during the war. Possibly the most extensive development of synthetic iron manufacture occurred in France during the war in the manufacture of cast iron shells. As much as 300 tons per day have been credited to the furnaces located at Livet, France, where a large hydroelectric development is located. The production of synthetic iron in France in 1914 produced by Keller is said to have reached the imposing total of 150,000 tons according to THE FOUNDRY, June 15, 1920.

Problems of the Industry

In the United States the production of synthetic iron was undertaken in 1917 by the Sweetser-Bainbridge Metal Alloys Corp., Watervliet, N. Y. Canadian foundries were active in using this process and their production reached 2500 tons per month during 1917. After the war demand died, the synthetic cast iron process saw little activity. With increasing knowledge of the process as well as furnace operation a definite revival has started, which will, no doubt, place this process on a definite basis where it will soon be recognized as a factor in the production of foundry iron.

The process requires scrap steel or iron for a basic charge, to which some suitable carburizer must be added, and then the whole is melted in the electric furnace using electric current as the source of heat. Where these three primary factors may be had at reasonable cost, it is obvious that the process will develop rapidly.

The problem in the manufacture of synthetic cast iron is that of melting steel scrap or turnings and at the same time introducing carbon into the mixture to gain iron of proper grade. The other alloys present in cast iron can be added to the metal in the ladle in the form of ferroalloys or to the furnace bath itself.

Definite control may be maintained over the carbon, silicon and manganese elements with the acid electric furnace, while the basic furnace gives control over all the principal alloying elements found in cast iron, carbon, silicon, sulphur, manganese and phosphorus. The early investigators encountered considerable difficulty in attaining the proper carbon content and this fact seemed to be of great moment until recent investigators have shown the way of correcting this apparent difficulty.

Robert Turnbull, in 1918, gave the following record shown in Table I of consecutive heats in making synthetic iron in the electric furnace. These results were obtained in the early stages of the synthetic process. It is of interest to note that steel scrap was the metal used in these charges.

Iron from Steel Scrap

Factors affecting the rate of carburization were studied by Williams and Sims and their results reported in a paper "Manufacture of Synthetic Foundry Iron in the Electric Furnace," before the American Foundrymen's association at its 1923 meeting. The results indicate that proper carburization may be obtained in a commercial way without causing serious difficulties. They give as a basic charge for 1-ton of synthetic iron the materials and amounts set forth in Table II.

Question naturally arises relative to the possibility of producing foundry iron from steel scrap in another type furnace. Some results have been obtained in this connection by such investigators as R. Moldenke, who reports in his text *The Principles of Iron Founding*, having melted thick plate steel scrap in the cupola by using unusually large fuel ratios. Tests of a similar nature are reported by W. B. Wallis. During the war, in Coblenz, Germany, attempts were made to make gray iron from an all steel scrap charge, an ordinary cupola being charged with 2 tons of coke to 7¾ inches above the tuyeres. After the blast was on, more coke and 350 pounds of burnt lime were charged. Then charges were added of 110 pounds of structural steel scrap. 200 pounds of coke and 66 pounds of lime. With the first 5 tons of scrap, 900 pounds of 10 per cent ferrosilicon was charged. When tapping, 110 pounds of 75 per cent ferrosilicon in lump form was added to the ladle. The iron obtained ran in carbon 2.70 to 2.95 per cent; in silicon from 0.60 to 0.70 per cent. However, the run had to be stopped, because the cupola

Costs Favor Process

Coke and pig iron command a much higher price in the Northwest than in the East and Middle Western states, due to the long haul by rail or water. Since the cost of shipping scrap cast is almost prohibitive, scrap prices are lower in the western regions. Electric power is cheaper than in many sections of the country and when some of the enormous power projects in the mountainous regions are finished costs will recede farther. This paper, which deals with the possibility of synthetic cast iron manufacturer in the Seattle district, was presented at the American Foundrymen's convention held at Syracuse, N. Y., last fall and owing to its length will be presented in two sections. The second part will follow in an early issue. The author, G. A. Schaller is connected with the department of engineering shops, University of Washington, Seattle.

became bright red about 20 inches above the tuyeres. The results obtained are far from satisfactory from the standpoint of gray iron. It is interesting to compare the results mentioned with those obtained by Williams and Terry, given in a paper before the Electrochemical society in 1922. These results are listed as follows:

Heat No. 748—Borings Charged

	Total carbon per cent	Silicon per cent
Charge analysis	3.44	2.12
Heat analysis	3.39	2.13

These results show a good gray iron made from practically the same material used in the German cupola experiments.

The writer conducted some tests with a cupola in the engineering shops at the University of Washington in attempting to produce synthetic iron. Extreme difficulty was experienced in raising the cupola temperature high enough to melt the steel scrap by using coke fuel. Retort carbon was tried in an effort to increase the temperature but poor results were obtained. The metal tapped from the cupola was dull and sluggish and entirely unfit for casting purposes. The metal did show a considerable gain in carbon, its analysis being around 2.5 per cent carbon, yet the results were of such an unsatisfactory nature that further experiments were foregone.

Use Electric Furnace

The conclusions to be drawn from the above discussion are that synthetic iron is a commercial possibility and that it must be produced by the electric furnace method. Moreover, synthetic iron presents a desirable manufacturing problem when its primary raw materials, steel scrap, carburizers and electric power are available at reasonable rates. The availability of these materials together with their costs will be discussed in detail in the following sections in which the writer shall endeavor to show synthetic iron production possibilities of the Seattle district.

The basis of the charges used in the electric furnace is steel scrap of various kinds or cast iron scrap, depending upon the character of the final product required. Steel scrap is used for the base charge, in making synthetic foundry iron, for a number of reasons. First, to produce a competitive foundry iron by the electric melting process, the so-called *raw* materials must be low in price to care for a fairly high melting cost resulting from the use of electrical power as compared with the relatively inexpensive coke of the cupola. Steel scrap is by far the cheapest material available. Yet, the term *steel scrap* covers a wide range of materials.

Best grades of this scrap viewed from a marketing standpoint are known as heavy melting scrap—a type of material commanding a price comparative to scrap cast iron, especially in eastern steel centers. From this classification, steel scrap ranges in price down to turnings, borings and light materials. It is the materials in this latter classification that do not command a satisfactory price because of a lack of market. Even in eastern mill centers such scrap is quoted several dollars a ton under the heavy melting type. The reason for this is not so apparent at first thought, especially when this material originates at or near the furnaces.

TABLE I

Heat Records of Electric Synthetic Iron

Heat No.	Silicon per cent	Sulphur per cent	Phosphorus per cent	Manganese per cent	Carbon per cent
254	1.02-L	.....	0.016	.....	3.42
255	1.10	.....	0.019	0.70	.....
256	1.15	0.023-H	0.017	.....	2.77-L
257	1.40	.....	0.015	.....	.....
258	1.18	.....	0.019	0.70	3.21
259	1.10	0.020	0.013	.....	.....
260	1.10	0.016	0.021	.....	3.32
261	1.06	.....	0.018	0.70	.....
262	1.00	0.019	0.016	.....	3.17
263	1.07	.....	0.013	0.74	.....
264	1.20	0.012	0.015	.....	3.48-H
265	1.28	.....	0.017	0.75-H	.....
266	1.12	0.011	0.021	.....	3.07
267	1.00	.....	0.014	0.74	.....
268	1.02	0.010	0.014	.....	3.09
269	1.02	0.011	0.039-H	.....	3.18
270	1.28	.....	0.032	0.69	3.36
271	1.07	.....	0.032	.....	3.05
272	1.10	0.009-L	0.021	.....	3.10
273	1.20	.....	0.030	0.68	2.93
274	1.72-H	.....	0.022	.....	3.21
275	1.12	0.012	0.028	0.66-L	3.40
276	1.02	.....	0.027	.....	3.22
277	1.25	0.010	0.013-L	.....	3.18
278	1.42	.....	0.014	0.66	.....
Average analysis	1.16	0.014	0.020	0 070	3.19

Silicon desired .....1.00 to 1.25, which is rather low.

Handling Costs High

An explanation lies in the fact that handling costs are high, due, as in the case of turnings to considerable bulk accompanied by light weight. Some experiments have been successfully conducted in briquetting this type of material to make it more desirable as well as economical for furnace use. This process involves the use of machinery and specially designed material handling equipment which always are attended by expense. Another point, is that the finer, lighter materials are given to rapid oxidation when melted in the open-hearth furnace. This means a higher melting loss and, consequently, a lower first cost for the material.

As a result of this condition, light scrap and turnings command practically no market in Seattle and are not greatly in favor with the dealers in scrap iron and steel. There exists in Seattle then, a material available for the synthetic process which has practically no market at the present time according to information advanced by scrap metal dealers. Steel scrap is desirable for the synthetic process because of its iron content. By using steel scrap no additions of a strictly ferrous material are necessary in the furnace. There are additional elements needed for an acceptable grade of foundry iron which are present in steel but in much smaller quantities than in gray iron. The entire process is built around recarburization of the iron present in the steel scrap to which ferroalloys are added in the proportions required to meet definite specifications.

The synthetic process will create a market for the off-brands of steel scrap in the Seattle district not only because of the cheapness of the scrap but because light scrap and turnings are adapted better to the electric furnace process. Turnings in themselves form almost an ideal material since they are thin in section and present maximum surfaces for a given weight of material. This results in better electric conductivity in the furnace and materially increases its operation through the fact that the charge heats more evenly and at an increased rate over that obtained with bulky material. Thus less time is required to melt the charge, which results in a lower production cost. However, of even greater importance is the fact that a market will be found for this class of material in the Seattle district on a

noncompetitive basis with markets already established.

A vast amount of steel scrap of all types is available in that district. A considerable amount comes from the three transcontinental railway systems whose terminals are located there. The exact figures on tonnages of scrap arising from this source are not available.

In addition to the railroad scrap, repairing and scrapping of automotive equipment is of considerable note. There is, of course, some cast iron scrap in an old automobile especially the motor and the transmission housings. The balance of the car largely is made of steel of light section. Since the trend in automotive body design is toward steel construction, the amount of steel scrap from the body will swell an already increasing total. Disk wheels also will find their way to the scrap yards.

Seattle, as a sea port secures a substantial quantity of steel scrap from ship repairs or in scrapping of obsolete boats. One of the best proofs of this situation is the quantities of chain of various kinds present in scrap metal yards.

The logging camps and saw mills are other heavy contributors to the scrap yard. In addition, some tin plate scrap is available from the can making factories in Seattle. There also is a wide diversity of metal manufacturing plants in that district which contribute to the steel scrap volume which may be used for synthetic iron.

Steel Scrap Markets

With such a large steel scrap production the matter of markets at once becomes important. It is rather difficult to recognize a definite market in Seattle so far as a *market price* is concerned. This statement is based upon the fact that the large mill centers are at a considerable distance from Seattle and prices quoted on steel scrap usually are the delivered price. This condition naturally has a suppressing effect upon the local market because dealers must pay a freight rate that amounts to a considerable portion of the delivered selling price.

Export trade in steel scrap now is not heavy. Figures from the customs office are shown in Table III.

It is interesting to note from these figures that the recovery of Japan from the earthquake disaster and China from the revolution directly is reflected in their respective steel scrap purchases. Better grades of scrap are exported, structurals being especially in demand. However, export business would not interfere with the market for synthetic scrap steel because the lighter materials are used in that process.

A local company, one of the largest steel scrap dealers, informed the writer that normally 2500 gross tons a month are available in excess of its demand. This means that approximately 3000 gross tons a month now are available in Seattle for the manufacture of synthetic iron. This estimate has been increased over that of the scrap steel dealer because of the availability of such material as turnings, borings, etc., for which no market now exists. To this may be added such materials as manganese steel and high silicon irons, which do not have a ready market but which are valuable in the synthetic process because of their composition.

TABLE II

Furnace Charge

Material	Quantity in pounds
Steel scrap, turnings, etc.	2,000
Carburizer	140
Ferrosilicon 50 per cent	80
Ferromanganese 80 per cent	10
Electrodes (carbon or graphite)	24
	10
Limerock or lime	150
	75
Fluorspar	20
Power, Kilowatt hours	750

A suitable carburizer is next in importance to a ferrous material as a base charge in the synthetic process. An efficient carburizer must be high in carbon and should be of a dense nature. Considerable work on this subject was done at the Northwest experiment station, United States bureau of mines, Seattle, by Messrs. Williams, Sims and Larson. In their paper, "Manufacture of Synthetic Foundry Iron in the Electric Furnace" read at a previous meeting of the American Foundrymen's association, they reported on the subject of carburizers as follows:

The purest and cleanest forms of carbon are the best carburizers. As the ash content of the carbon increases, more of it must be used and the rate of carburization will be slower. Artificial graphite electrode or resistor carbon, petroleum coke, gas-retort carbon, and pitch coke, are the best carburizing materials. Wood charcoal ranks high because of its purity but is not as effective as the ones mentioned above because its apparent specific gravity is so low that it floats on the bath, giving poor contact. Coke and anthracite coal of low ash content come next in preference, and the high ash cokes last. Silicon carbide is an excellent carburizer but must be used with one of the forms of carbon above mentioned and only in sufficient quantity to introduce the required silicon in the metal.

Of the materials mentioned retort carbon, charcoal and coke are available as local products. Retort carbon is a by-product of a local gas plant. Charcoal is being made from sawdust by a firm in Bellingham. This process is new and only limited information is available on the subject. However, this type of charcoal may be used successfully in some briquetted form. It may be possible to use a pitch binder with the sawdust charcoal so that a product of suitable density and specific gravity would result. This material would form a low cost carburizer and its constituent parts are available in inexhaustible quantities in the Seattle territory. In addition to the carburizers mentioned, it should be pointed out that beehive coke is produced at Wilkeson and Snoqualmie, both near Seattle. These cokes, while available for the process, have the high ash content objection. Work is under way at both plants which will result in a lower ash content through washing the coal. It is conceivable that a market created for their product through the synthetic process would stimulate the production of a lower ash coke.

By-product coke is available from British Columbia as well as the ovens of western Europe at a price below domestic eastern coke. This coke is low in ash and would, therefore, form a desirable carburizer.

Electrical Power Available

As pointed out previously, the synthetic process of producing foundry iron in the electric furnace revolves around the availability as well as the cost of the electric power required. The largest production of this process has been achieved at Livet, France. While the modifying circumstances are not entirely available yet the fact remains that Livet is the location of a hydroelectric development of considerable proportions. This leads to the natural assumption that electrical power is available in quantity and at a sufficiently low cost to make the synthetic process a commercial possibility.

Electrical power is available in Seattle from two power companies. The facilities for furnishing uninterrupted service by both these companies adequately are taken care of through a combination of hydroelectric developments supplemented by steam driven plants. A similarly favorable condition exists throughout the state of Washington.

The results of recent power developments indicate the necessity for a market to absorb the increased power output.

The synthetic process of making foundry iron is well beyond the ex-

perimental stage and furthermore power costs are low in Seattle. As a result, there exists a fortunate condition of circumstances decidedly in favor of a synthetic industry in that city. The matter of costs in this connection will be discussed in the section on costs.

Discussion so far as the electrical power situation is concerned all has been from the standpoint of the user. Apparently, the introduction of a synthetic foundry iron industry is just as desirable to the power companies because use could be made of the off-peak load and generators could be run to more nearly normal capacities throughout the 24 hours of the day. At the present time the peak hours in Seattle extend from 4:30 p.m. until 9:30 p.m., a total of five hours. The hours of this peak indicate that the lighting load is of greatest moment in Seattle, a fact which is consistent with the lack of individual manufacturing enterprises on anything approaching large scale production. The total off peak hours total nineteen which would give ample time for several furnace runs daily.

TABLE III

Export Figures

Destination	Amount in gross tons
1923	
Japan	2,852
China	178
Canada	104
Kevanting	100
	3,334
1924	
Japan	3,148
China	1,289
Canada	408
Honkong	34
Kevanting	20
	4,899

To show the importance of off-peak loads it may be said that the local power companies offer a reduction of 25 per cent for power used during that time. Such a reduction, in addition to quantity discounts offered from the basic rates, will react favorably on power costs. There is nothing, of course, to prevent operation of the synthetic furnace for the entire 24 hours in the event of contingencies arising demanding such procedure—yet such operation obviously would result in higher power costs, which immediately would be reflected in the costs of the iron produced.

The fact that peak hours occur only at one period during the day is in favor of electric furnace operation because only one shutdown is necessary in the day's run and the consequences attendant upon cooling such as lining deterioration are minimized. It has occurred to the writer that since there is only a five-hour peak load period, some methods of banking the furnace such as introducing coke upon the hearth might be employed to prevent serious cooling of the furnace. Another possibility is the continued operation of the furnace through the peak period at a much reduced rate—just enough current being used to keep the furnace heated.

Trolley Wheels Crack in Cooling Process

Question: We have an order for trolley car wheels, but the first three wheels cracked and we shall appreciate any information you can give us on the proper method for making these castings and the kind of iron required to pour them. Have you any back numbers of THE FOUNDRY containing articles covering this subject or do you know of any book that would be of assistance to us.

Answer: Manufacture of chilled car wheels either small or large represents foundry business and invariably causes trouble in any jobbing shop that attempts it. The subject was treated exhaustively by the late H. E. Diller in a series of six articles that appeared in THE FOUNDRY from April 1 to June 15, 1920. We have no back numbers containing these articles, but you may be able to secure them from a subscriber who has kept a complete file, or you may be able to consult them in the nearest large public library.

The design of the wheel, the thickness of the chill, the temperature of the iron, the method of annealing, the iron mixture are important factors that exert a direct bearing on the success of the process and a proper understanding of these factors and the relation they bear to each other only can be gained through experience.

It is no use trying to make these castings from an ordinary foundry mixture. After you have gained experience through experiment you will be in a position to try other combinations, but in the beginning you had better confine your mixture to one made up of old car wheels 50 to 70 per cent, pig iron 30 to 50 per cent. From 10 to 25 per cent of the pig iron is of the kind known as charcoal iron and the remainder is bessemer iron. Calculate the mixture to show a silicon content of from 0.80 to 1 per cent and sulphur not higher than 0.09 per cent. The wheels must be annealed after they are cast.

Utilize Powdered Coal

(*Concluded from Page* 669)

contemplated in the location of the sea coal department to a more convenient place closer to the main service station.

After the first filling the tanks are replenished indiscriminately according to their requirements. For example each melting furnace consumes coal at the rate of approximately 2000 pounds per hour. The tank has a capacity of 10 tons, or sufficient to run an ordinary heat. Although fuel may be added at any stage, convenience dictates the practice of refilling the tanks between heats wherever practicable.

Definite figures are not available on the saving effected by the change from hand to automatic firing with powdered fuel. Conditions vary in different localities, but any foundryman can figure for himself the saving to be effected by the abolition of firemen, coal passers and ash handlers. The furnace heats up more rapidly, thus shortening the melting period and prolonging the life of the furnace to a corresponding extent. Under perfect combustion conditions the full value of the fuel is realized. Definite and uniform temperatures are maintained in melting furnaces and annealing ovens.

From the various illustrations it may be noted that with slight variations the same device is used to take the coal from the hopper and send it through the pipe leading to the burner. A screw conveyor geared to handle a definite amount in a given period of time, takes the coal from the bottom of the tank and delivers it into a chamber from which it is drawn by a fan driven by a small motor.

The amount of air which is drawn through with the coal is regulated by a disk which may be moved by hand to admit greater or lesser amounts through a funnel connected to the coal chamber. The volume and character of the resulting flame are controlled by adjustment of the air inlet.

Other interesting features about the plant of the Albion Malleable Iron Co. include a recently completed chemical and physical testing laboratory fitted with all the necessary equipment for keeping a close check on the product. A nicely appointed and fully equipped pattern shop in which a dozen patternmakers constantly are employed is located on the second floor above part of the cleaning room.

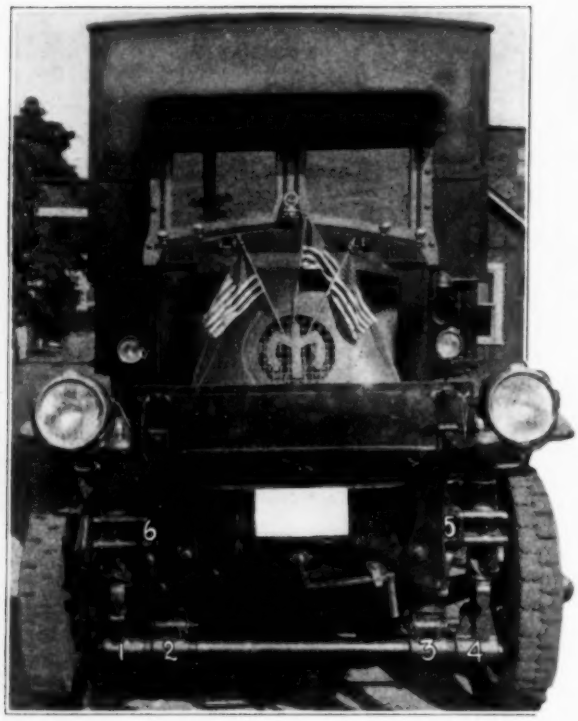


Fig. 1—The Parts Marked from 1 to 6 Are Made of Crucible Steel in the Connecticut Foundry

Auto Parts Are Cast *From* Crucible Steel

By H. R. Simonds

FEW castings in service today are called upon to withstand such severe strains as the castings used on motor trucks. The modern heavy truck is a marvel of ruggedness and serviceability, for day after day they pound along over all kinds of roads carrying heavy loads of freight on schedules, and giving reliable service. Naturally, many of the castings found on heavy trucks either are malleable iron or steel. The six front castings shown in Fig. 1, which support the air spring mechanism found on certain types of trucks, are made of steel, which is melted in crucibles in an interesting foundry in Connecticut.

The Nutmeg Crucible Steel Co., Stony Creek, Conn., operates two oil fired crucible pits each holding eight crucibles of 115 pounds capacity each. These pits are simple in construction, being merely fire brick lined boxes set in the floor of the foundry into which the crucibles are placed. These pits are covered with fire brick bungs or sections. The oil burner, which consists of two pans placed one above the other and extending the full width of the pit, is located at the front and near the top of the furnace. The oil is fed into the top pan and drops from it into the second pan, combustion taking place from both pans. The flue outlet, which is at the bottom of the rear wall, is adjustable. The secret of operation, according to D. E. Peterson,

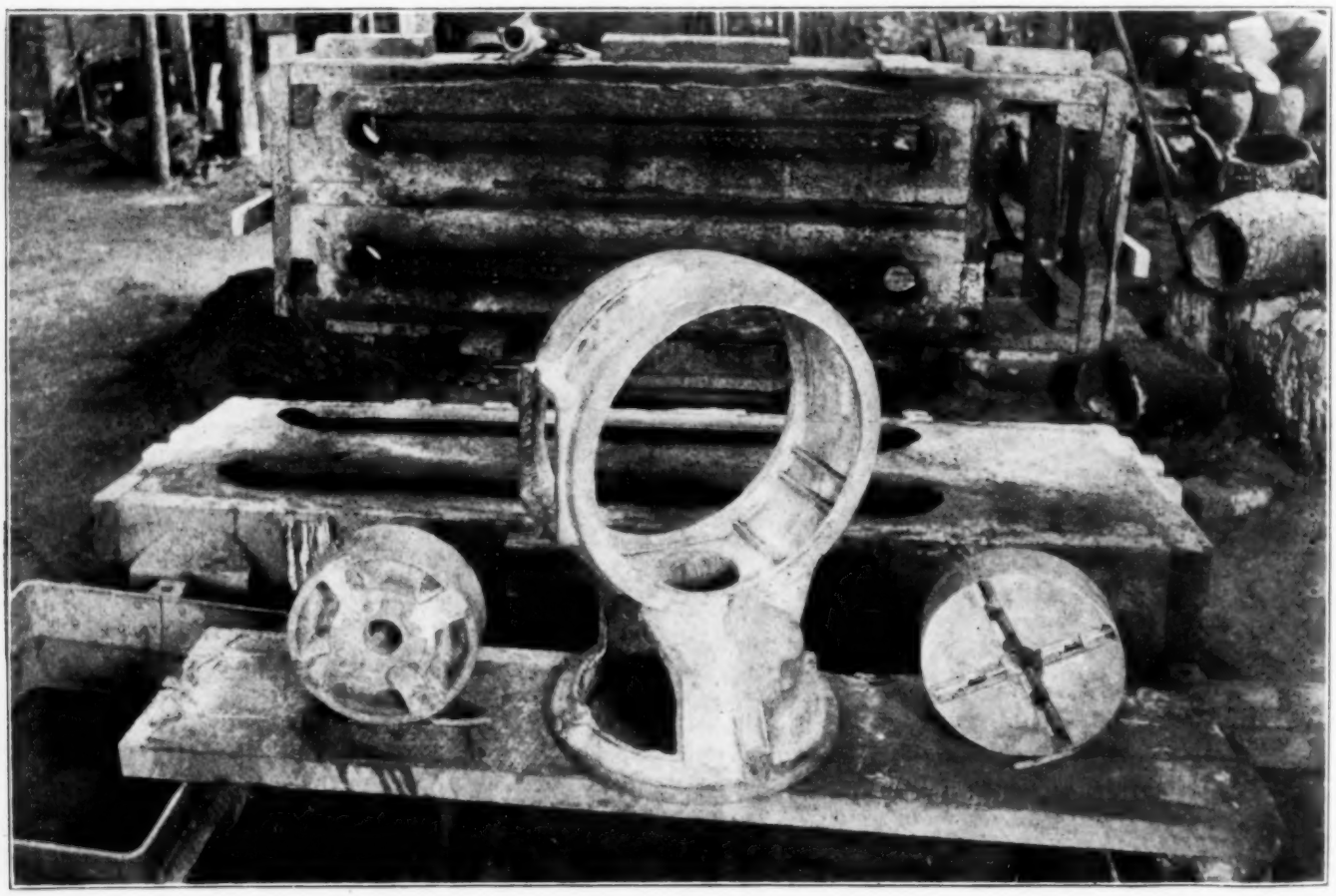


FIG. 2—A DIFFERENTIAL CASTING HAVING A ¾-INCH WALL AND REQUIRING GREAT CARE IN MOLDING AND POURING

who is in charge of the work, is in the correct regulation of the flue opening and the oil feed.

Melting procedure is as follows. The furnace is started at 3:30 in the morning. A half inch or so of ground graphite is sprinkled over the floor to prevent the crucibles from sticking. The charge of eight crucibles is prepared and set in the furnaces. Usually the floor crucibles at the rear are new, and always those at the front are old. This method is used because the new crucible requires some seasoning before it can take the full close blast of the flame. At 7:30 the first heat is taken from the front four crucibles and the back four are then moved forward to the front, and four additional crucibles are placed at the back. From that time on at intervals of two hours the front four crucibles are removed and poured, the back four moved to take their place, and four new charges set at the back.

FIG. 4—EVERY TWO HOURS SECTIONS ARE REMOVED FROM THE FURNACE AND FOUR CRUCIBLES ARE POURED

FIG. 3—CHUCK CASTINGS ARE MADE SUCCESSFULLY FROM CRUCIBLE STEEL

The operation of the second pit furnace is identical, but frequently is timed so that pouring takes place every hour. The charge in each crucible is made up by placing a half pound of charcoal at the bottom of the pot, then 60 pounds of sprue, and from 50 to 55 pounds of low sulphur, low phosphorus, boiler punchings, having an analysis of 0.20 carbon. During melting the top is lifted off occasionally and the contents of each pot is stirred with a steel rod. Five minutes before pouring a quarter of a pound of 78 per cent ferromanganese and three quarters of a pound of 50 per cent ferrosilicon are added to each pot, and the pot stirred. Immediately after this the oil supply is shut off.

Actual pouring is accomplished quickly to maintain as even a temperature as possible throughout the four crucibles. A trolley rail extends over the center of each furnace, and the crucibles are lifted out by a lever and tongs attached to this trolley. Two men, who are waiting, take each crucible as it comes from the furnace, carry it to the skimming floor where the slag is skimmed off, and where an eighth of a pound of aluminum is added to quiet the liquid. Nearly all castings are bottom gated and poured on edge, that is, with the thinnest portion in a vertical plane.

The average casting develops a tensile strength of 85,000 pounds per square inch, and the average price is from 15 to 40 per cent higher than for other steel castings. One of the chief items of expense in this process is for crucibles, since one will last for

(*Concluded on Page* 693)

FIG. 5—THE MOLDS ARE SET ON EDGE FOR POURING WHENEVER POSSIBLE

A. F. A. Awards Medals to European Foundrymen

ON THE recommendation of the board of awards of the American Foundrymen's association, the board of directors has approved the granting of gold medals to three prominent European foundrymen and metallurgists. Eugene V. Ronceray, Thiais, France, has been chosen to receive the J. H. Whiting gold medal; John Shaw, Sheffield, England, to receive the John A. Penton gold medal, and Prof. Thomas Turner, Birmingham, England, has been honored with the Joseph S. Seaman medal.

Prof. Turner is one of the British metallurgists whose work has been of fundamental importance in cast iron. John Shaw, a foundryman and student of casting metallurgy, has been influential in the development of British foundry practice. E. V. Ronceray is recognized as being a foundryman largely instrumental in the development of French foundry practice.

These gold medals which are to be presented at the thirtieth annual convention of the American Foundrymen's association and second International Foundrymen's congress to be held at Detroit from Sept. 27 to Oct. 1, are three of the four medals authorized by the association for presentation to outstanding men connected with the foundry industry. The medals were made possible by gifts contributed by John A. Penton, first secretary; Joseph S. Seaman, third president; W. H. MacFadden, tenth president and J. H. Whiting, vice president in 1906. The medals will be presented at the annual banquet to be held Thursday evening, Sept. 30.

EUGENE VICTOR RONCERAY who is to be awarded the J. H. Whiting gold medal of the American Foundrymen's association at the 1926 Detroit meeting is president of S. A. des Establissements Bonvillain et Ronceray, Choisy-le-Roi, near Paris. He also is president and managing director of the Universal System of Machine Molding & Machinery Co.

E. V. RONCERAY

Ltd., London, and director of studies at the Foundry High school, Paris.

Mr. Ronceray, born Nov. 15, 1869, took his engineering degree in 1891 at the Ecole Nationale des Arts et Metiers, Chalons. From 1891 to 1897 he was professor at the Institution Parangon, near Paris, where he first was educated and he prepared students desirous of following the course of the National Schools of Arts and Manufacturers. In 1897 he took a post with the Paris-Lyon-Mediterranee railroad. Later he became connected with Mr. Bonvillain with whom he established the first manufacture of molding machines in France. He became manager and then managing director of the company.

Mr. Ronceray has devoted the greater part of his life to foundry practice. He is one of the founders of the Association Technique de Fonderie de France of which he is vice president and has been a member of the council since its foundation. He has contributed a considerable number of articles, papers and lectures. In the United States he lectured in 1907 at Pittsburgh, Boston, New York and Providence, illustrating his subject with moving pictures. He presented a paper at the Foundrymen's congress in Philadelphia in 1907 and at the Rochester convention in 1922, and took an active part in the various conventions of foundry associations in Belgium, Great Britain, Czecho-Slovakia and France. He was on the organizing committees of various foundry exhibitions and conventions, including the exhibition of Torino, Italy, in 1911, and the international congress held in France during 1923. Since 1923 he has been chairman of the committee of papers of the French foundry association.

In 1921 Mr. Ronceray originated the idea of a special foundry school in a lecture which he delivered in Liege, Belgium. Three years later the first foundry school was inaugurated in Paris. During the international congress of Paris in 1923 he created the international committee in charge of new testing methods for cast iron with representatives from America, Belgium, Czecho-Slovakia, France, Great Britain, Italy, Spain and Switzerland. He is a member of many scientific and technical institutions, including a charter membership in the American Foundrymen's association.

THOMAS TURNER, to be presented with the Joseph S. Seaman gold medal of the American Foundrymen's association, has for years been professor of metallurgy,

THOMAS TURNER

Birmingham university, Birmingham, England. Professor Turner is known to foundrymen the world over for his research on the influence of silicon on cast iron. He also has done much useful and important work in the field of nonferrous metals. It is due to the energy and able work of Prof. Turner that the metallurgical school at Birmingham university has attained prominence.

Prof. Turner was born in 1861, educated in the schools of Edgbaston and

was graduated from the Royal School of Mines, London. While he kept closely in touch with commercial, metallurgical and foundry problems, these interests never resulted in the neglect of the purely teaching side, and he is well known as an able lecturer.

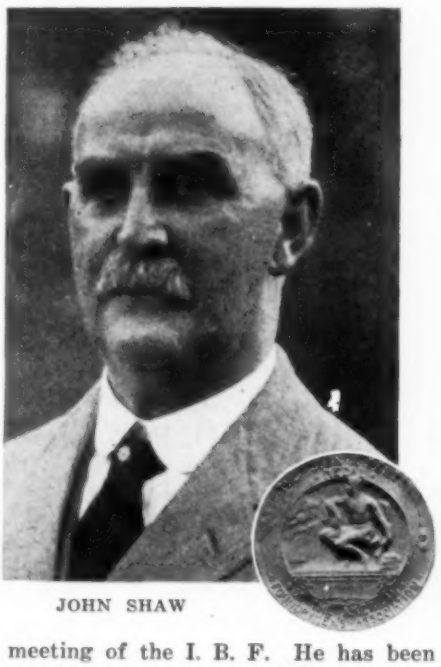
He has written several books on metallurgy, the first in 1895, "Metallurgy of Iron," followed by "Lectures on Iron Founding," and "Practical Metallurgy." In addition to these he has published over a hundred papers on metallurgical and educational subjects. Prof. Turner was presented with the Bessemer gold medal in 1925 by the Iron and Steel Institute in recognition of services to the iron and steel industry. As a further mark of esteem the Birmingham university awards the Thomas Turner gold and bronze medals for prizes in metallurgical work done by the students. Professor Turner has contributed papers to the meetings of the American Foundrymen's association and was made an honorary member of this association in 1901. He is a member of the Iron and Steel institute, president of the Institute of Metals, member of Institute of Mining and Metallurgy and many other organizations.

JOHN SHAW, who is to receive the John A. Penton gold medal of the American Foundrymen's association at the second International Foundrymen's congress, is one of the foremost British foundrymen and has contributed extensively to the technical press on practical and metallurgical phases of the foundry industry.

He was educated at the Farnworth grammar school, Widnes technical school, and Liverpool university. After completing his education Mr. Shaw served his time as apprentice with the Widnes Foundry Co., and owing to his ability was made assistant foreman at the age of 19. He was in full charge of a foundry at 22. After six years in charge of a small foundry in Wales he became foundry manager for Cochrane and Co., Ltd., Dudley. During the war Mr. Shaw was director of the gray iron castings section of the British ministry of munitions. For the past several years he has been manager of the Newhall Works of the Brightside Foundry & Engineering Co., Ltd., Sheffield, in which plant castings up to 120 tons in weight have been made.

Mr. Shaw has been prominently identified with foundry organization affairs for many years. He joined the Institute of British Foundrymen in 1906. He was president of the Birmingham branch for three years and is now president of the Sheffield branch. He is the third oldest British member of the American Foundrymen's association, which he joined in 1910. Mr. Shaw represents the Institute of British Foundrymen on the international committee appointed to work out standardized tests for cast iron. He is also the delegate of the Institute of British Foundrymen to the British Engineering Standards association.

As a fitting tribute for his distinctive and valuable services to the foundry industry of Great Britain, Mr. Shaw was presented with the Oliver Stubbs gold medal at the 1924



JOHN SHAW

meeting of the I. B. F. He has been selected to present the 1926 exchange paper on behalf of the Institute of British Foundrymen at the Detroit meeting of the A. F. A.

Nicholls Increases Capitalization

Wm. H. Nicholls Co. Inc., Brooklyn, N. Y. manufacturer of molding and sand handling equipment, has increased its capital stock to $600,000. The firm recently completed a new plant at Richmond Hills, Long Island, N. Y. to supplement its plant in College place, Brooklyn. The purpose in enlarging the plant was to increase the facilities to manufacture a more extensive line of molding machines of large and small sizes and also to increase the facilities to manufacture sand handling and mold conveying equipment.

Samuel Arnold has been appointed representative in the Pittsburgh district by the Pennsylvania Pump & Compressor Co., Easton, Pa.

Continuous Melting for Weight Castings

Question: Kindly advise me how to melt old tin scrap in the cupola to furnish metal for sash weights poured in chill molds. I want to melt continuously and slowly, not over 3 tons per hour. I have a cupola with a 49-inch shell lined down to 37 inches.

Answer: Your cupola has a melting capacity of 8000 or 9000 pounds per hour and to melt at a slower speed you either will have to reduce the lining or reduce your blast pressure. A single brick lining laid flat against the present lining will reduce the inside diameter of the cupola by about 5 inches and a 32-inch cupola has a melting capacity of about 3 tons per hour. In suggesting a reduction of the blast pressure we naturally assume that you still will employ your present blower. A reduction of the blast pressure will mean a reduction of the volume of air entering the furnace. The actual blast pressure indicated on the gage does not furnish information of any value unless one knows the volume of air being delivered. For example a large blower running slowly and showing a 6-ounce pressure on the gage is delivering a greater volume of air than a small blower running at racing speed and showing twice the pressure.

In your case you know from actual observation that at a given pressure your cupola will melt at a certain speed. It follows that if the pressure is reduced, the volume will be reduced correspondingly and the speed of melting also will be reduced in the same proportion. However, variations either in the pressure or volume of the blast are only possible within comparatively narrow limits. If the blast is reduced to too great an extent, the iron will melt at too low a temperature. Iron melts to the best advantage at the upper limit of a furnace's capacity and therefore it is preferable to provide a cupola of the proper diameter for a given output, rather than attempt to regulate the output by manipulating the blower. Also you probably will find that to produce hot iron at a lower speed than that to which you have been accustomed to running the cupola, you will have to change the relative weight of the iron and coke in the charge.

High tuyeres and a deep bed are two of the main requisites in attempting to run long heats in a cupola. To these must be added provision for the ready removal of slag. Sufficient limestone, fluorspar or oyster shells must be added to produce a liquid slag that will flow freely.

Improve Gray Iron Properties by Heat Treatment-II

By O. W. Potter

TO TIE up in some way the results of the transverse test on bars of different dimensions, the modulus of rupture was calculated from the data of both tests and the results compared. The original arbitration bars, 1¼ inches by 15 inches were tested in the rough and the small bars tested after being machined. The machined bars (small bars) would be expected to give the more uniform results and also a higher modulus of rupture which they did in practically every case.

The formulas used in calculating are as follows:

$$S = \frac{Mc}{I}$$

S = Modulus of Rupture = breaking load in pounds per square inch
M = Moment of applied load
c = Distance of extreme fiber from neutral axis
I = Moment of inertia

For middle loading:

M = ¼ Pl

$$I = \frac{1}{64}\pi d^4$$ (for circle with axis through center)

P = load applied
l = length of beam

$$\text{Therefore, } S = \frac{Mc}{I} = \frac{(\frac{1}{4} Pl) \times r}{1/64\,\pi\,(2r)^4} = .318\frac{Pl}{r^3} + \frac{2.544\,Pl}{d^3}$$

This formula holds only up to the elastic limit and therefore these results are not strictly correct because they involve data taken beyond the elastic limit.

G. B. Upton in his text book "Materials of Construction" gives the following formula:

$$T = \frac{3}{bh^2} \cdot M \left\{ 1 + \frac{1}{\sqrt{\frac{Ec}{Et}}} \right\}$$

T = Calculated tensile strength
b and h = dimensions of cross section of rectangular bar.
M = Moment
Ec = Modulus of elasticity in compression
Et = Modulus of elasticity in tension

He states Ec is usually twice Et. Since the moduli of elasticity of cast iron is such a variable quantity and rather difficult to determine it seldom is given any value. For that reason the above formula involves the determining of the moduli of elasticity on every batch or test made. The results then are only approximate. For this reason the simple modulus of rupture formulae was used and is sufficient for purposes of comparison.

One of the serious objections to the transverse test is the fact that it cannot be compared with any other results, or strength properties of any other materials unless tested with the same shaped and sized cross section bar and with the same distance between supports. In discussing the strengths of materials and comparing them with cast iron, tension or compression is usually the means of comparison. For this purpose the transverse test is not entirely satisfactory. For weak, brittle materials it is an easy test to make but there is some question if another test could not be used which would be more valuable for comparative purposes.

The moduli of rupture for the two kinds of bars as calculated are given in Table VII.

Test Physical Properties

IN THIS article, the second of a series, the author gives the results obtained from the various tests for tensile, transverse and impact properties. Results of tests for dimensional changes and hardness also are given. These tests show in detail the effect of heat treating on the physical properties of cast iron.

Results of Tensile Tests

Twelve bars were tested in tension to compare the results with the other physical properties. It will be noted that with the exception of specimen No. 12, all semisteel specimens were from 25 to 50 per cent stronger than the gray irons. It seems possible that specimen No. 12 is a semisteel and was tagged wrongly. The results are shown in Table IX. Neglecting No. 12, the average tensile strength of the semisteel is 33,226 pounds per square inch while it is only 23,276 for the gray iron. On the other hand the cast iron showed an average elongation of 3.5 per cent and the semisteel only 2 per cent.

To establish a relation between tensile strength and transverse strength

Table VII

Effect of Size on Transverse Properties

Spec. No.	Standard Bars Def. inches	Standard Bars Load pounds	Small Bars Def. inches	Small Bars Load pounds	Modulus of Rupture d = 1.25	Modulus of Rupture d = 0.5
11 C. I.	0.16	3400	0.06	440	53,185	53,815
15 C. I.	0.15	3400	0.07	535	53,185	74,600
16 S. S.	0.20	4400	0.07	473	64,600	57,000
17 C. I.	0.17	3750	0.07	502	58,500	59,500
20 C. I.	0.17	3400	0.085	520	53,185	59,900
21 S. S.	0.18	4600	0.06	660	71,700	75,900
22 S. S.	0.18	4640	0.12	550	72,500	66,200
23 C. I.	0.20	3800	0.08	513	59,400	61,700
24 S. S.	0.19	4750	0.07	638	74,100	77,700
25 C. I.	0.19	3800	0.02	660	59,400	80,400
26 C. I.	0.18	3700	0.10	423	57,700	68,900
28 C. I.	0.15	3400	0.04	187	53,000	42,400
30 C. I.	0.16	3600	0.07	539	56,200	64,500
31 S. S.	0.20	4850	0.09	273	75,700	53,900
32 S. S.	0.18	4450	0.07	594	69,500	72,800
33 S. S.	0.18	4700	0.065	543	73,400	68,300
34 C. I.	0.16	3750	0.04	522	53,500	69,400
35 C. I.	0.18	3800	0.06	484	59,300	63,600
41 S. S.	0.17	4300	0.07	598	67,100	73,200
44 C. I.	0.16	3500	0.06	520	54,600	60,800

Table VIII

Effect of Heat Treatment on Impact Properties

(The impact values are given in foot-pounds per square inch)

Spec. No.	Untreated	T-1	T-2	T-4	T-5	T-6
11 C. I.	18.8	.....	.....	.....	16.3	.....
15 C. I.	23.8	25.6	.....	.....	.....	.....
16 S. S.	29.0	.....	.....	.....	.....	28.0
17 C. I.	17.2	20.4	.....	.....	.....	.....
20 C. I.	21.0	29.1	.....	.....	.....	.....
21 S. S.	20.5	.....	.....	27.0	.....	.....
23 C. I.	21.6	.....	27.3	.....	.....	.....
25 C. I.	14.7	16.4	.....	.....	.....	.....
26 C. I.	19.0	.....	.....	18.8	.....	.....
27 S. S.	20.9	.....	.....	20.3	.....	.....
28 C. I.	27.3	.....	.....	17.1	.....	.....
30 C. I.	18.0	.....	.....	17.5	.....	.....
31 S. S.	20.4	.....	.....	15.2	.....	.....
33 S. S.	26.4	25.0	.....	.....	.....	.....
34 C. I.	20.1	.....	29.6	.....	.....	.....
36 S. S.	25.3	.....	.....	.....	.....	36.7
40	23.8	15.9	.....	.....	.....	.....
41 S. S.	28.6	.....	.....	27.1	.....	.....
43	25.8	.....	33.0	.....	.....	.....
44 C. I.	24.4	.....	22.0	.....	.....	.....
46 S. S.	25.6	.....	.....	.....	30.0	.....

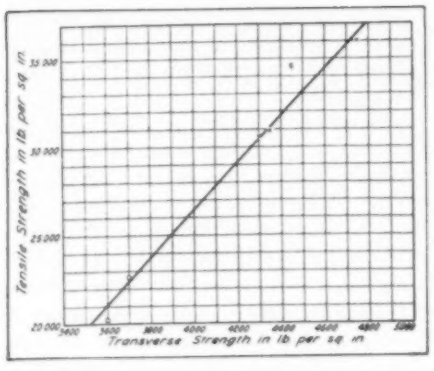


FIG. 7—CURVE SHOWING THE RELATION BETWEEN TRANSVERSE AND TENSILE STRENGTH

the graph shown in Fig. VII was drawn.

Broken specimens from the transverse test on the ½-inch diameter bars were cut to lengths of about 3 inches and tested on a charpy impact machine set with the jaws 2 inches apart. The bars were tested without notching. The following formulae were used to convert the readings into KgM and these values were then converted in foot pounds.

1. Dh = ho—h
   Dh = Difference between free swing of pendulum and swing when breaking specimen.
   ho = Height of free swing of pendulum.
   h = Swing of specimen after breaking specimen.
2. h x w = E
   w = 23.19 Mg (Wt. of pendulum)
   E = Energy absorbed in breaking specimen in meter kilograms.

The fact that the bars used in this test were not standard and that the gage lengths between the jaws of the machine also were not standard makes it impossible to compare these results with standard tests. However, the results of these tests on semisteel and on gray iron are comparable and furnish a means of comparing the impact properties of the two materials and of studying the effects of heat treatment on this property. The data are given in Table VIII.

Some interesting relations are shown by these results. On heat treatment T-1 (heating above critical and cooling rapidly) four out of six tests showed a decided increase in impact values. Under heat treatment T-4 (heating above critical and cooling slowly in furnace) only one out of seven tests showed an increase while most of them showed a decided decrease in impact values.

When quenched from above the critical in both water and oil (T-2 and T-6 respectively) three out of four tests showed a decided increase in impact values. When quenching from below the critical (T-3 and T-5) the results are rather erratic, one each of the water and oil quench showing a marked increase and the other two showing a slight decrease.

It is quite evident that the impact values are sensitive to the effects of heat treatment and it might be advisable to study their relation further, with reference to commercial use.

While the brinell and scleroscope hardnesses in general indicated the same tendencies, the brinell seemed to be more definite in those indications. Ordinarily in metals or alloys the brinell value usually is considered proportional to the ultimate strength and the scleroscope proportional to the elastic limit. See graph of Fig. 8. With the exception of specimen No. 12, the points indicate that brinell hardness is roughly proportional to ultimate tensile strength. The x

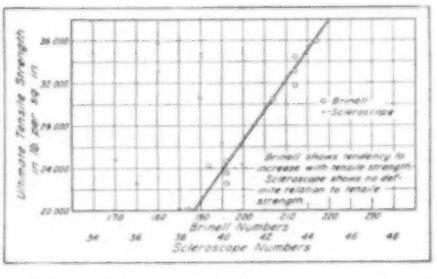

Ultimate Tensile Strength in lb per sq in
Brinell
Scleroscope
Brinell shows tendency to increase with tensile strength. Scleroscope shows no definite relation to tensile strength.
Brinell Numbers
Scleroscope Numbers

FIG. 8—TENSILE STRENGTH IN RELATION TO HARDNESS

marks indicate the scleroscope hardness and they seem to have no particular relation to ultimate tensile strength. The elastic limit of cast iron is known to vary from 0 up to near the ultimate strength, depending upon its chemical composition and the condition of the elements in the specimen. It is not possible to say whether the scleroscope readings are a function of the elastic limit or not.

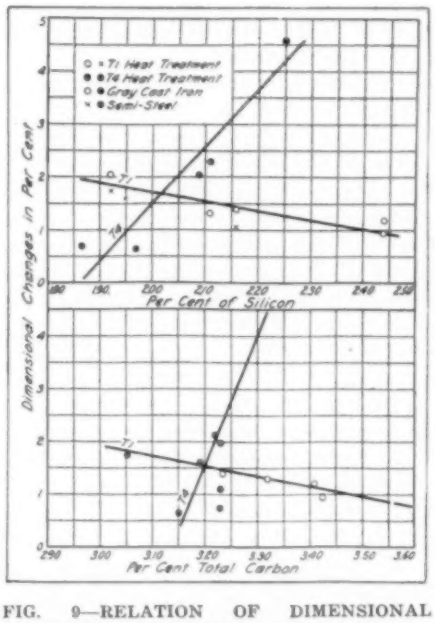


FIG. 9—RELATION OF DIMENSIONAL CHANGES TO SILICON AND TOTAL CARBON UNDER HEAT TREATMENTS

Table IX

Tensile Strength

Spec. No.	Tensile strength lb. per sq. in.	Elongation
1 C. I.	21,340	4%
1 C. I.	26,200	2%
2 S. S.	34,560	4%
3 S. S.	33,250	1%
5 S. S.	31,920	1%
6 C. I.	22,640	4%
7 S. S.	30,640	2%
9 C. I.	20,200	2%
12 C. I.	34,640	5%
15 C. I.	24,920	4%
24 S. S.	35,960	2%
45 C. I.	24,360	5%
Average Values:		
Ave. C. I.	23,276	3.5%
Ave. S. S.	33,226	2%

Fracture—Granular.

Wide variation in the values of the quenched specimens indicate that the temperature of quench and the chemical composition of the specimens will influence greatly its final properties after quench.

Oil quenched specimens show a marked tendency to soften when quenched from below the critical and to harden when quenched from above the critical. The results of the water quench show a similar relation except that they are more pronounced. It was impossible to drill those specimens quenched from above the critical in water, while those quenched from below the critical drilled easily.

Other investigators have found these same results. Harper[6] and Forsyth[7] found that when the specimens were quenched from temperatures between 700 and 800 degrees Cent. there was a softening effect.

Results of this series of tests are given in Table X. The experimental methods are given in connection with that table.

Heat treatments, T-3 and T-5, water and oil, respectively, are quenched from below the critical in oil and water respectively from above critical show practically no change.

Permanent growth is shown distinctly in all specimens not quenched. In all quenched specimens there was a tendency toward a shrinkage instead of a growth. It is interesting to note that those indicating definitely a shrinkage were those that were quenched from 735 degrees Cent. which is just below the critical for this material as determined by thermal analysis. This would seem to indicate that there is a shrinkage in volume of gray cast iron and semisteel at a temperature somewhat below the critical. This possibly may be due to spheroidizing and decomposition of cementite.

It has been contended by most in-

[6]Vol. 30, Trans. Am. Fdry Assoc.

[7]Met. Thesis, 1924, University of Minnesota.

Table X

Effect of Heat Treatment on Dimensions of Gray Cast Iron and Semisteel

Specimens were marked with center punches approximately 5" apart and 0.052" holes drilled. Four gage lengths at right angles to each other were marked on each specimen and the distances measured with a strain gage before and after heat treatment. The average of the readings for each specimen is as follows:

Spec. No.	Length before treatment	Length after treatment	Change in length	Per cent change in length	Heat treatment
15 C. I.	5.063	5.130	0.067	1.32	T-1
17 C. I.	5.078	5.139	0.061	1.20	T-1
19 C. I.	5.075	5.123	0.048	4.6	T-1
20 C. I.	5.083	5.294	0.211	1.4	T-1
25 C. I.	5.104	5.176	0.072	0.95	T-1
33 S. S.	5.079	5.184	0.105	2.07	T-1
40	5.093	5.165	0.072	1.42	T-1
42 S. S.	5.091	5.177	0.086	1.69	T-1
23 C. I.	5.075	5.070	0.005	0.0	T-2
34 C. I.	5.078	5.086	0.008	0.0	T-2
43	5.054	.....	Shrank	.....	T-3
44 C. I.	5.092	5.058	—0.034	—0.67	T-3
21 S. S.	5.086	5.167	0.081	1.59	T-4
26 C. I.	5.077	5.181	0.104	2.06	T-4
27 S. S.	5.078	5.167	0.089	1.75	T-4
28 C. I.	5.113	5.232	0.119	2.33	T-4
30 C. I.	5.072	5.139	0.067	1.17	T-4
31 S. S.	5.087	5.114	0.037	0.73	T-4
41 S. S.	5.084	5.117	0.033	0.65	T-4
11 C. I.	5.076	5.040	—0.036	—0.71	T-5
46 S. S.	5.074	5.053	—0.021	—0.41	T-5
16 S. S.	5.099	5.106	0.007	0.0	T-6
36 S. S.	5.035	5.137	0.102	2.03	T-6

NOTE: All changes are increases except as indicated.

vestigators that the phenomenon of growth in cast iron is due to graphitic carbon. There has been some controversy in regard to the exact condition of the graphite. Recent experimenters have shown conclusively graphite in cast iron to be crystalline[8]. The different forms of carbon (graphite, diamond, charcoal, etc.) indicate it has a number of stable forms which vary considerably in density. Experiments on heating graphite and cooling rapidly by quenching have greatly raised the density. This is the same as reducing the volume for a given mass. Under the above quenching conditions this seems to be borne out. The condensing of the graphite under quenching has the effect of reducing the dimensional values.

The fact that this did not occur on specimens heated above the critical and quenched probably is due to the absence of the graphite which has gone into solution in the ferrite as austenite.

Average growths under the various heat treatments were as follows:

Heat treatment	Growth in per cent
T-1	+1.92
T-2	0
T-3	—0.67
T-4	1.47
T-5	—0.56
T-6	0

The greatest average dimensional change (increase) occurred when the test bars were heated above the critical and cooled rapidly without quenching. Under the long soaking in the furnace as in T-4 there seemed to be less permanent growth.

All the above effects suggest that the carbon may be going through an allotropic change with a corresponding change in space lattice and density on heating which is only partially reversible on slow cooling. This would be a reasonable explanation if there were a specific limit of this growth when all of the graphitic carbon had undergone this change. The experiments of Outerbridge[9] and others, however, seem to show no such growth limit under repeated heating and cooling. The absorption of gases from the furnace atmosphere and the formation of gases by oxidation at the high temperatures have been proposed by some to account for the growth of cast iron and this should receive at least some consideration in connection with this investigation. It is well known that gray iron is a quite pervious metal and the circulation of gas is no doubt an influencing element on the growth phenomena. To carry out this part of the work it probably would be necessary to vary the composition of the furnace atmosphere and to make analyses of the gases contained in the specimens before and after heating (heat treating). Lack of time and apparatus have prevented including such tests in this work.

Plotting the dimensional changes against silicon and total carbon content shows some rather unexpected tendencies. The graphs are shown in Fig. 9. Upon heating above the critical, holding 3 hours, cooling to black in 15 minutes and then cooling rapidly in air (T-1) the tendency is quite distinct that the dimensional changes increase with decreased quantities of silicon and total carbon. This is quite the reverse of what would be expected if the phenomena of growth were due entirely to the amount of graphite present, since graphitic carbon is known definitely to be high in the high silicon irons, which is confirmed by the chemical analysis of this investigation. When cooling in furnace slowly from above the critical as in T-4, the results seem to be reversed and growth increases with increase in silicon and total carbon content.

More investigations must be done before any definite conclusions can be drawn.

[8]E. Adamson. THE FOUNDRY, September, 1923.

[9]Journal of Iron and Steel Inst. Vol. 83, No. 1, p. 643.

Book Review

Construction and Operation of the Steel Converter and Small Bessemer, by Hubert Hermanns, 247 pages, 6¼ x 9½ inches; published by Wilhelm Knapp, Saale, and furnished by THE FOUNDRY at $3.50 in paper and $4 in cloth and in Europe by Penton Publishing Co., Ltd., Caxton House, London, for 15 shillings and 20 shillings, net, respectively.

The former work by this author, "The Modern Siemens Martin Furnace," received so kindly a reception from critics the world over that he was encouraged to write the present volume along the same lines, treating it from the historical point of view as well as from the engineering. Portraits of Bessemer and Thomas, inventors of the converter principle, adorn the volume, as well as 217 illustrations and charts, many tables and a complete bibliography.

An interesting bird's-eye presentation of the various iron and steel processes is presented in a two-page reproduction of a diagram and cross section of various types of plants engaged in production of these materials. Construction and operation of the early types of converters are described and illustrated. An interesting feature throughout the entire work is a series of cross sections and ground plans of representative German plants devoted to production of converter steel, giving the practical solution of the problem in addition to the theory.

Throughout, the volume gives evidence of earnest investigation and desire to present the subject fully and to show all sides of the problems accompanying production of converter steel. The text is in German.

Sullivan Machinery Co., Chicago has removed its Boston office to 45 Milk street.

How Phosphorus Influences Carbon in Cast Iron

Experiments of the Author Recounted in Paper Prepared for the Recent A. F. A. Convention—Former Investigations Reviewed

By James T. MacKensie
American Cast Iron Pipe Co., Birmingham

INFLUENCE of phosphorus upon the total carbon content of cast iron first was noted by Stead[1] in 1900. He noted the two following pig irons of similar analysis except the carbon and phosphorus:

	Hematite Pig Iron	Cleveland Pig Iron
Silicon	2.80	2.80
Sulphur	0.03	0.03
Manganese	0.85	0.75
Phosphorus	0.04	1.56
Graphitic carbon	3.95	3.63
Combined carbon	0.15	0.12

Since the 1.56 per cent phosphorus in the Cleveland pig iron is equivalent to about 10 per cent Fe_3P, the total carbon and the other 90 per cent would show 4.16 per cent as against 4.10 per cent for the hematite. Reasoning from this that pure iron should contain 4.60 per cent carbon and no Fe_3P he drew up Table I showing the probable relation between phosphorus and total carbon. He checked his calculations by a series of melts made at one time in a five-compartment crucible. The result is recorded in Table II.

In 1908 Wust[2] published an account of a much more comprehensive series of crucible melts with thermal data, not included in this paper, showing the relations presented in Table III where *A* shows results on melts raised to 1300 degrees Cent., and allowed to cool slowly for thermal investigation. The melts under *B* were held at the freezing point, or just above it, for one hour. Both sets were made under a cover of sugar carbon.

A pure iron of the following analysis was obtained by Coe[3] in 1914: Total carbon 4.24 per cent; silicon 0.95 per cent; manganese 0.70 per cent; sulphur 0.017 per cent; phosphorus 0.025 per cent. He made a series of melts in crucibles which gave the values as shown in Table IV.

Coe's results do not show any difference between 0.25 phosphorus and 1.07 per cent phosphorus although by Stead's assumption the 1.07 per cent phosphorus should appear with 3.93 per cent carbon and the 0.25 per cent phosphorus with the 4.16 per cent carbon. Some disturbing influence probably was responsible although the 0.28 per cent phosphorus with only 4.04 per cent carbon shown by Wust seems to corroborate Coe. His 0.88 per cent phosphorus with 3.98 per cent carbon is closer to Stead's figures than Coe's.

All the foregoing investigations were made in crucibles under laboratory conditions and the application of the principle to ordinary foundry condition does not appear to have been made by any writer on the subject.

Some preliminary experiments on this same subject were carried out in the preparation of a paper entitled The Standard Test Bar for Cast Iron Pipe presented by the author before a meeting of the American Society for Testing Material in 1924. The results are summarized in the accompanying tables. Table V shows the results of various melts where the iron with a phosphorus content of 0.8 per cent was taken from one car. Ferrophosphorus was added in the cupola to the first two heats.

Table VI shows results from melting another pig iron containing originally 0.45 per cent phosphorus. A 0.70 per cent addition of phosphorus in the cupola caused a carbon drop of 0.16 per cent.

With the foregoing for a foundation further experiments were tried with the various brands of pig iron shown:

	1	2	3
Silicon	2.10	1.43	1.94
Sulphur	0.040	0.013	0.035
Manganese	0.70	0.52	0.54
Phosphorus	0.06	0.02	0.19
Vanadium	0.01	0.01	0.03
Titanium	0.03	0.02	0.09
Carbon	4.05	3.07	4.12
	4	5	6
Silicon	0.99-1.34	2.42	4.70
Sulphur	0.30-0.05	0.05	0.033
Manganese	0.35-0.80	0.94	0.73
Phosphorus	0.33	0.45	0.75
Vanadium	0.01	0.02	0.10
Titanium	0.02	0.07	0.22
Carbon	3.87	3.66	2.99

The first is a low phosphorus iron made from steel scrap in a hot blast coke blast furnace. It is intended pri-

Table I

Calculated Relation Between Phosphorus and Carbon

Pure Iron	Phosphide	Phosphorus	Total Carbon
100	None	None	4.60
75	25	3.89	3.45
50	50	7.78	2.30
25	75	11.67	1.15
None	100	15.58	None

Table II

Observed Relation Between Phosphorus and Carbon

Phosphorus	Carbon
None	4.15
4.10	3.25
7.90	2.00
13.00	0.70
16.00	Nil.

Table III

Results of Thermal Investigation Tests

A		B	
Phosphorus	Carbon	Phosphorus	Carbon
0.02	4.27	0.02	4.27
0.21	3.98	0.07	4.22
0.38	3.80	0.28	4.04
1.21	3.61	0.88	3.98
2.69	3.18	2.34	3.34
3.11	3.12	3.27	3.29
3.71	3.02	3.94	2.88
4.27	2.63	4.61	2.41
5.47	2.31	5.80	2.24
6.19	2.15	6.55	2.14
6.89	1.73	8.17	1.89
10.94	1.55	11.72	1.36
11.66	1.34	13.90	0.80
13.53	0.85	21.56	0.28
21.56	0.28		

Table IV

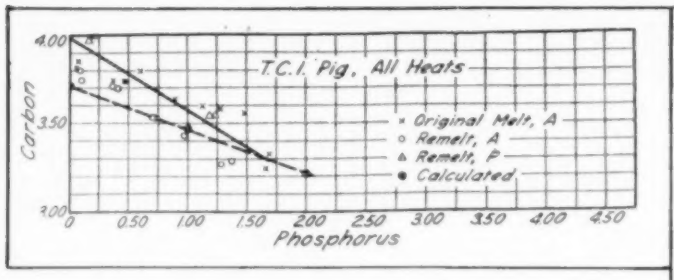
Tests in Low Phosphorus Iron

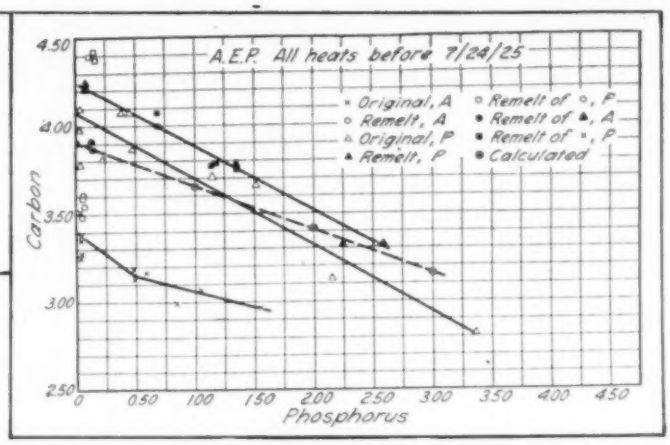
Phosphorus	Carbon
0.025	4.23
0.25	4.00
0.45	4.04
0.76	4.06
0.84	4.00
1.07	4.01

[1]Iron and Phosphorus. Journal Iron and Steel Institute, 1900, Part 2.

[2]Beitrag zum Einfluss des Phosphors auf das System Eisen-Kohlenstoff.

[3]"Phosphorus in Cast Iron," Staffordshire Iron and Steel Institute, 1914.



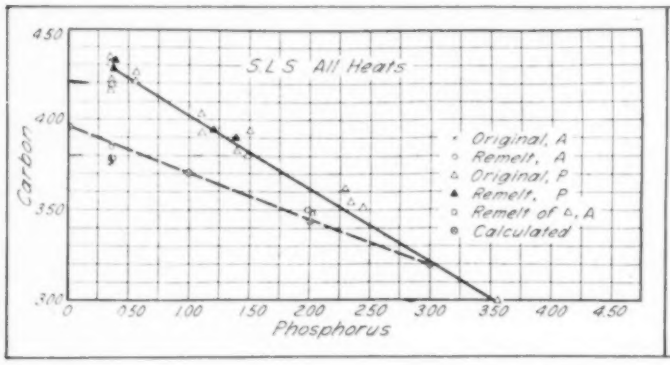


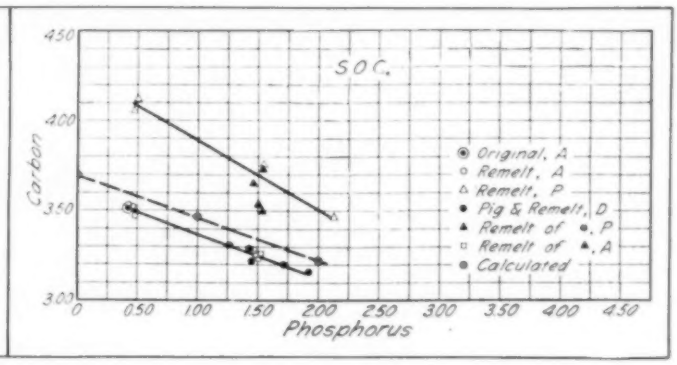
FIGS. 1 AND 2—SHOWING THE TOTAL CARBON PLOTTED AGAINST THE PHOSPHORUS PIG IRON MARKED NO. 1 IN THE LIST ON PAGE 681 WAS USED IN THE TESTS SHOWN IN FIG. 1 AND PIG IRON MARKED NO. 2 WAS USED IN THE TESTS SHOWN IN F

marily for making ingot molds. The second is a synthetic pig iron made in a basic electric furnace from steel scrap. No. 3 is a normal malleable iron. No. 4 is a charcoal iron made with a warm blast and unfortunately somewhat mixed. No. 5 is a coke made iron and is the same as that shown in Table VI. The high silicon iron No. 6 was used in a few heats.

All melts were made in an 18-inch cupola built by the Whiting Corp., Harvey, Ill., mainly for experimental purposes. A small fan furnished sufficient blast at 4 to 5 ounces pressure to melt the iron at a speed of about 1200 pounds per hour, or a single tap of 100 pounds every 5 minutes.

The detail report of 30 tests shown in Table IX is fairly typical of the entire list of nearly 500 tests made altogether during this investigation. The date followed by the letter indicating the kind of coke and the mix in pounds per charge are shown initially. This is followed by the order in which the samples were tapped with the number of the test bar set in the proper position. Results of the drop test are





FIGS. 3 AND 4—ADDITIONAL TESTS SHOWING THE CARBON PLOTTED AGAINST THE PHOSPHORUS. A WARM BLAST CHARCOAL IRON (NO. 4 IN THE LIST) WAS USED IN THIS SERIES OF TESTS IN FIG. 3. THE IRON LISTED AS NO. 5 WAS USED IN THE TESTS SHOWN IN FIG. 4

Table V

Ferrophosphorus Added to First Two Heats

Heat No.			Total Carbon	Silicon	Phos.	1500 pounds Defl.
55	A	P	3.34	1.83	1.36	1.75
62	A	P	3.41	1.87	1.30	0.195
68	A	Mn	3.50	1.93	0.8	0.20
67	A	Mn	3.53	1.95	0.8	0.205
122	B	....	3.53	1.97	0.83	0.21
66	A	....	3.46	2.05	0.8	0.21
54	A	....	3.45	1.82	0.81	0.21
61	A	....	3.53	1.96	0.8	0.21
58	A	....	3.52	1.87	0.8	0.215
118	A	....	3.46	1.95	0.8	0.22
59	A	FeSi	3.40	2.30	0.77	0.22
57	A	....	3.51	1.95	0.84	0.225
119	A	....	3.65	1.94	0.8	0.24
120	A	LS	3.48	1.94	0.81	0.245
121	A	LS	3.59	2.16	0.8	0.26

Table VI

Phosphorus Added in Second Heat

Heat No.		Total Carbon	Silicon	Phos.	1500 pounds Defl.
13	P	3.73	2.34	0.45	0.36
29	P	3.57	2.20	1.12	0.285

Standard Methods

Four brands of coke were tried during the series of experiments indicated by the letters *A*, *P*, *D* and *B*. The coke marked *A* is by-product with an ash and sulphur content of 10.00 and 0.6 per cent respectively. The second is a pitch coke with ash 0.4 and sulphur 0.4 per cent. The third is a 96-hour beehive coke in which the ash is 17.00 per cent and the sulphur is 1.7 per cent. The fourth variety also is a beehive coke showing an ash content of 4.00 per cent and sulphur 0.5 per cent.

Method of molding and breaking the bars, sampling and analysis were similar to those described in the paper previously mentioned (*Transactions* A. S. T. M., Vol. 24, Part 2, pp 664) except that a chromic-sulphuric acid bulb was substituted for the zinc and phosphorus towers in the carbon train.

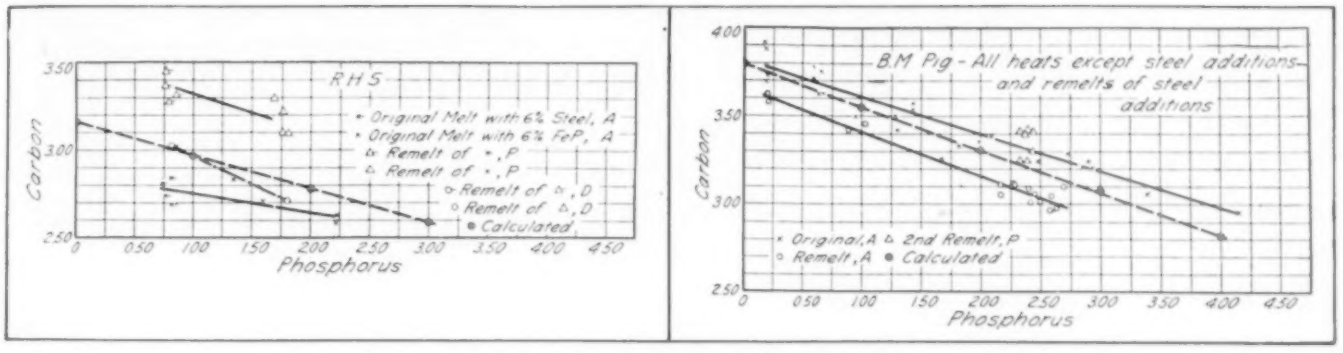
Table VII

Heat	Tap	Carbon	Phos.
3/12	2	4.13	0.50
	3	3.76	1.53
	4	3.47	2.12
2/26	1	4.26	0.57
	2	3.83	1.40
	3	3.00	3.55
	4	3.55	2.34
2/19	1	3.86	0.48
	2	3.14	2.16
	3	2.82	3.36
2/18	1	4.08	0.39
	2	3.34	2.52
	3	3.71	1.15

Table VIII

Results on Iron Below Saturation Point

Heat	Carbon	Phos.
2/11	3.38	0.04
	3.53	0.04
2/12	3.13	0.49
	3.17	0.59
	3.00	0.85
2/13	3.19	0.48
	2.96	1.55
	3.06	1.04


R H S
× Original Melt with 6% Steel, A
× Original Melt with 6% FeP, A
△ Remelt of ×, P
△ Remelt of ×, P
○ Remelt of △, D
○ Remelt of △, D
● Calculated
Carbon
Phosphorus
B.M Pig - All heats except steel additions and remelts of steel additions
× Original, A △ 2nd Remelt, P
○ Remelt, A ● Calculated
Carbon
Phosphorus

FIGS. 5 AND 6—CONCLUDING TESTS SHOWING THE TOTAL CARBON PLOTTED AGAINST THE PHOSPHORUS. IRON MARKED NO. 6 IN THE LIST WITH AN ADDITION OF 6 PER CENT STEEL WAS USED FOR THIS TEST IN FIG. 5. A MALLEABLE PIG IRON MARKED NO. 3 WAS USED IN THE TESTS SHOWN IN FIG. 6

shown together with the ultimate breaking load and the deflection at 1500 and 1900 pounds. The 1900 pound point is included for the cast iron pipe makers and the 1500 pound point is used for general comparison. It is high enough to get a fair value and low enough to reach nearly all the weak bars. In a few cases extrapolation of the bending bars had to be employed to get even this value. These results are all corrected to the standard 1 x 2-inch section. Young's modulus of elasticity may be calculated from them by the simple equation:

E=2,592,000/f f=Deflection at 1500 pounds

E=3,283,000/f f=Deflection at 1900 pounds

Graphs of the total carbon plotted against the phosphorus are shown in Figs. 1 to 6. The line marked *calculated* was found by taking Dr. Moldenke's figures for the system iron-carbon-silicon (Principles of Iron Founding) using the average silicon of the series to arrive at the base and calculating the 1.00 per cent, 2.00 per cent and 3.00 per cent phosphorus points by Stead's assumption referred to in the first part of this paper.

Complications introduced by the change of coke on some of the melts were due to the necessity of getting as much carbon in the high phosphorus as in the low phosphorus bars. Otherwise a true estimate could not be made of its influence.

In examining the graphs it is well to bear in mind that considerable variation existed in the composition of the iron marked No. 6. The synthetic pig iron No. 2 had a carbon content of only 3.07 per cent and therefore was sensitive to cupola conditions. Many of the melts with pitch coke were hypereutectic and gave trouble in pouring from the continuous elimination of graphite. This familiar phenomenon around a blast furnace is not so much in evidence in the vicinity of a cupola.

Extent to which the graphite is thrown off was strikingly shown in the analyses of two sets of bars poured from the same ladle of iron. After the first set was poured the metal in the ladle was stirred for two minutes with a steel rod. In compar-

Table IX

Part of the Data Recorded in the Investigation

Heat Data	Tap No.	T. C. Per cent	Phos. Per cent	Si.	Ev. S.	Mn.	G. C.	C. C.	Ox. S.	1500	1900	Ultimate Strength Pounds	Deflection in Inches	Crop
1/5 A	1	3.83	0.06	1.93		0.61								
T. C. I. 100	154	3.86	0.08	1.88	0.052	0.59	3.04	0.82	0.064	0.275		1820	0.38	
1/13A	1	3.75	0.10	1.62		0.51								
T. C. I. 33, Scrap 1/5—67	159	3.80	0.09	1.75	0.062	0.54	3.00	0.80	0.070	0.27	0.40	1960	0.43	
1/17 P	1	3.97	0.16	1.60		0.42								
Remelt of 1/13	163	4.00	0.22	1.62	0.070	0.40	3.18	0.82	0.079	0.25	0.35	2140	0.45	12.5
1/6 A	1	3.75	0.37	1.75		0.62								
T. C. I. 100, FeP 2	155	3.75	0.48	1.84	0.058	0.61	2.96	0.79	0.060	0.21	0.30	2100	0.37	
	3	3.75	0.47	1.81		0.62								
1/14 A	1	3.70	0.41	1.49		0.56								
TCI 33, Scrap 1/6, 67 FeP 2	160	3.72	0.36	1.65	0.054	0.54	2.89	0.83	0.064	0.21	0.29	2200	0.36	
1/7 A	1	3.80	0.60	1.58		0.57								
TCI 100, FeP 4	156	3.65	0.89	1.70	0.057	0.57	2.88	0.77	0.070	0.18	0.24	2300	0.33	10
1/15 A	1	3.54	0.70	2.16		0.48								
TCI 33, Scrap 1/7 67 FeP 1, FeSi 1	161	3.54	0.72	2.12	0.055	0.52	2.81	0.73	0.077	0.19	0.26	2250	0.32	10
1/8 A	1	3.60	1.12	1.61		0.59								
TCI 100, FeP 6	157	3.58	1.27	1.60	0.057	0.60	2.82	0.76	0.066	0.18	0.24	2190	0.29	9
1/12 A	1	3.25	1.65	1.98		0.45								
TCI 100, FeP 10, FeSi 0.6	158	3.34	1.69	1.93	0.070	0.50	2.69	0.65	0.078	0.16	0.20	2600	0.33	9.5
	3	3.56	1.48	2.04		0.51								
1/16 A	1	3.29	1.37	2.13		0.41								
TCI 33, Scrap 1/12 67 FeP 3, FeSi 1	162	3.27	1.28	2.14	0.063	0.46	2.65	0.62	0.091	0.17	0.22	2330	0.28	
	3	3.43	0.97	2.36		0.47								
1/18 P	1	3.55	1.19	2.10	0.076	0.35								
Remelt of 1/16	164	3.55	1.23	2.07	0.077	0.39	2.85	0.70	0.087	0.185	0.25	2580	0.37	11
2/10 A	1	3.28	0.04	1.30	0.034	0.42								
AEP 100	165	3.27	0.04	1.31	0.029	0.46	2.32	1.05	0.026	0.155	0.20	3180	0.44	
Sluggish Heat	3	3.38	0.04	1.30	0.033	0.42								
2/11 A	1	3.38	0.04	1.33	0.035	0.42								
ADP 100	166	3.53	0.04	1.32	0.037	0.46	2.65	0.88	0.039	0.17	0.24	2900	0.45	

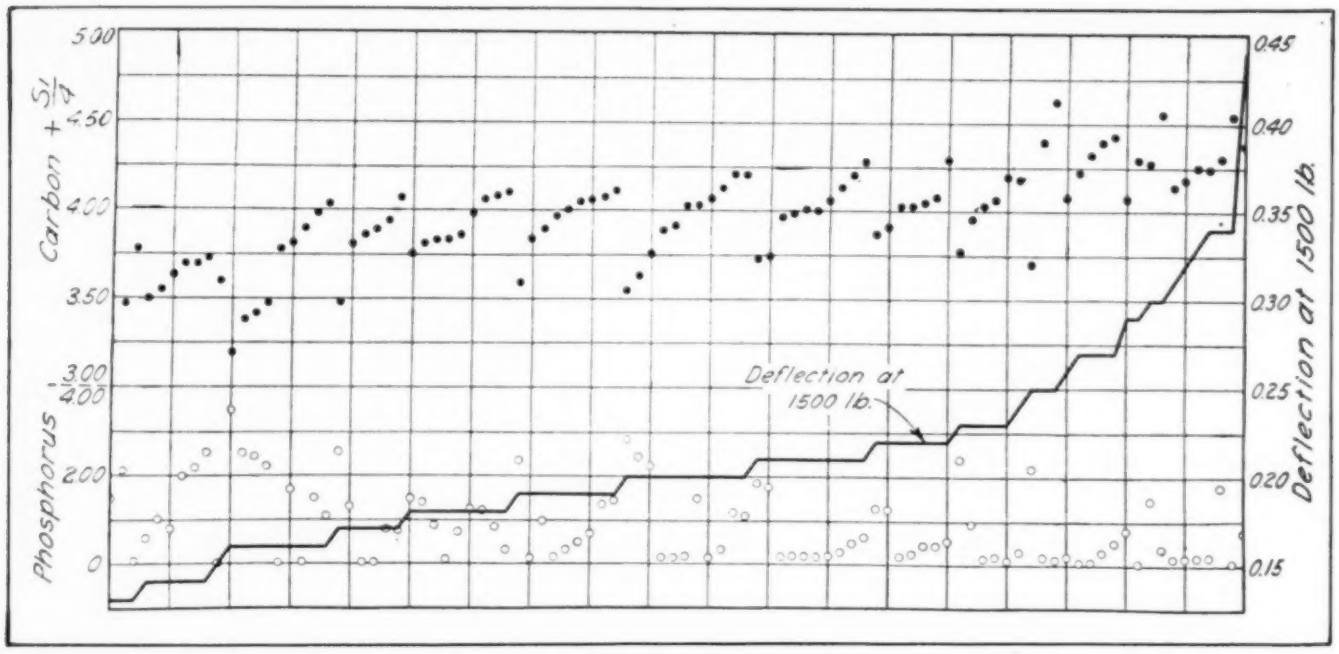


FIG. 7—RESULTS FOR CARBON PLUS ONE-FOURTH SILICON, PHOSPHORUS AND THE DEFLECTION AT 1500 POUNDS PLOTTED FOR EACH SET OF BARS ARRANGED IN THE ORDER OF THEIR DEFLECTION AT 1500 POUNDS

ing results it was found that the total carbon had dropped from 4.07 to 3.93 per cent, the graphite from 3.30 to 3.06 per cent, the deflection at 1500 pounds from 0.27 to 0.22, the breaking load rose from 2200 to 2400 pounds and the drop test went from 11 to 12.5 inches.

Carbons were checked carefully in each of the four tests. The figures given represent an average of four determinations that agreed closely on the total and graphitic carbons.

The series with the pig iron marked No. 2 in the list showed that not only does the phosphorus throw carbon out of the solution but that it prevents solution when the metal is considerably below the carbon saturation point. This is shown in Table VIII where conditions were identical in heats 2/11, 2/12 and 2/13. The carbons were even higher on one of the cold heats, 3.23, 3.27 and 3.38 per cent, than they were on the brilliantly hot metal poured from heats 2/12 and 2/13. All are far short of their carbon saturation point which is shown in Fig. 2.

Fig. 7 shows the results for carbon plus one fourth silicon, phosphorus and the deflection at 1500 pounds, plotted for each set of bars arranged in the order of their deflection at 1500 pounds. Fig. 8 shows the carbon plus one fourth silicon against the deflection with the approximate phosphorus content denoted by the characters. The line drawn on Fig. 8 is taken from the graph previously mentioned which appeared in a paper presented by the author before a meeting of the American Society for Testing Materials in 1924. These graphs are published with considerable hesitation. They are at variance with popular belief and with Wust's[4] monumental work, but they are too striking to omit.

In Fig. 7 except for the first sets with deflections of 0.13 and 0.14 the high phosphorus bars have much lower carbon plus one fourth silicon for a given deflection than the medium and low phosphorus bars. The abnormally high values for carbon plus silicon one fourth almost without exception are accompanied by low phosphorus. In Fig. 8 the wildest results are those for the low phosphorus above the line and for the high phosphorus below the line, thus indicating that phosphorus actually increases the deflection at a given load.

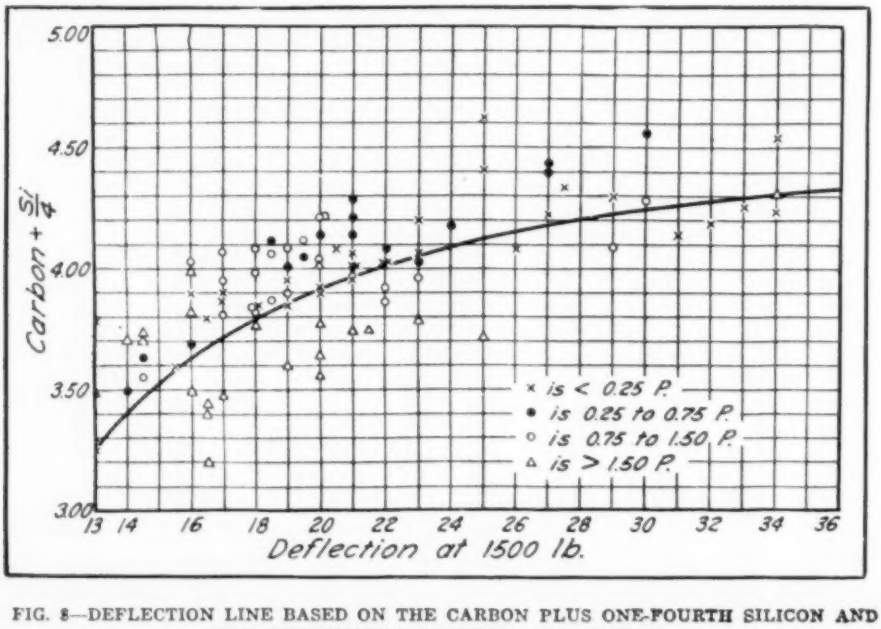


FIG. 8—DEFLECTION LINE BASED ON THE CARBON PLUS ONE-FOURTH SILICON AND THE PHOSPHORUS CONTENT OF THE BARS

[4]"Einfluss des Phosphors auf die Mechanischen Eigenschaften des Grauen Gusseisens" (Ferrum, Vol. XII, 7-1925).

Cast Iron Replaces Hollow Log Pipes

Hollow log gas pipes laid at Lincoln, Nebr., in 1872, in the first crude attempts to supply *modern conveniences*, recently have been dug up and replaced by cast-iron pipe. The pipes were pitch soaked, made of 8-inch logs with walls 2 inches thick. They were in good condition and still in use. The log pipe will be placed in a local museum.

How and Why in Brass Founding

By Charles Vickers

Eliminates Scabbing

We would appreciate your suggestions on methods to eliminate the forming of sand and metal scabs on the interior of large bronze centrifugal pump castings. The foundry states such are due to the weight and thickness of the castings (1½ inches) but inasmuch as the outside surfaces are flawless this does not seem logical. On examination we find the cored surfaces to be covered with scabs in such size and quantity that the pump efficiencies can never be realized without excessive chipping out, which we doubt of being able to do as the scabs appear to have been chilled. Apparently the core sand does not hold up as well as the molding sand.

If it is possible to get the ouside surfaces smooth and flawless, why not the inner surfaces? The answer is that this foundry is weak in its core-making department. Probably those in charge are not accustomed to making large cores and are using the same mixture for the heavy pumps as they are accustomed to using for small cores. From the description of the scabbing, a considerable amount of molding sand is being used in the cores. This chokes the vents, or clogs up the interstices between the sand grains making it impossible for the gas to escape to the vented part of the core. The gas then accumulates at points under the skin of the core and the pressure increases to the point where a section of the core is blown off. The sand is distributed throughout the metal of the casting, or is accumulated in some favorable situation and may not show on the outside of the casting.

The best remedy is to insist on such cores being made by a competent coremaker because he will know exactly what to do in such a case. He will know he has to use a free venting core sand, which means a mixture containing little, if any, molding sand. This he will bond probably with oil, although other binders can be used and are also good and he will protect his core with a coating of some refractory paint, such as plumbago.

In a core made of silica sand with vents well distributed and near the surface of the core; *open in structure*, the hot liquid metal can enter between the grains of sand. To prevent this coat the core surface thinly with a paint of finely screened carborundum fire sand mixed with silicate of soda water, which closes the large spaces, and on this paint plumbago to get a smooth coating on the core.

Have Large Losses

We experience large losses because some of our castings show porosity after they are finished, and also they are too rough to suit our class of trade. In addition to the above troubles we have losses due to leaky castings, and so you better can understand, we send you samples of broken castings for fracture examination. You will note the broken casting shows a green spot on the fracture and all castings that leak have the same green spots in the fractures. The castings are made in green sand molds using a No. 8 sieve to cover the patterns, and we finish the molds with a spray of 1 part linseed oil to 3 parts kerosene, which gives good results. We also have used flour but this showed no improvement. The metal is melted in coke-fired crucible furnaces and is poured around 2150 degrees Fahr. We send you samples of our sand both new and old also of core sand with cores, and of the coke we are using.

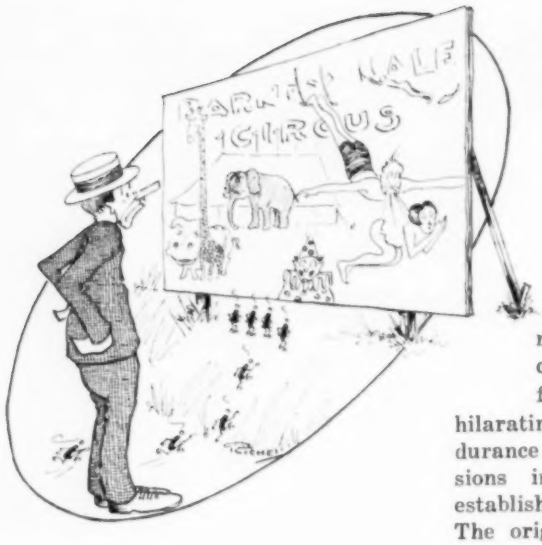
We can tell nothing from an inspection of the castings. A superior alloy would be one containing less zinc, as high zinc, red brasses fail to flow into the mold with the smoothness that characterizes the low zinc, red brasses. An analysis would determine that point one way or the other; if the alloys are the same then the competitor is using more new metal, for his sample shows a better color, and such colors cannot be obtained with ordinary ingot metals. It is necessary to *build up* such metal with a considerable percentage of virgin metal. The analysis of the metal is not given. The data that is given is too meager to permit of proper advice being given, because it will be all guess work. The molding sand both new and old, samples of which have come to hand, is fine, but at the same time it appears to possess enough permeability to permit the gases generated to pass away and produces a smooth skin on the castings. The core sand is also fine, but the core sent is inferior to those made in this country by core machines, and which like the sample core submitted, are never vented. This core appears to contain too high a percentage of binder as it is too close for an unvented core.

The small pits that pepper the surface of the defective castings appear to be caused by loose sand, in fact some of them are filled with sand. Zinc oxide also appears to have caused some pits, also a too energetic application of the vent wire will help to produce them. The green spots shown in the fractured surfaces are caused by pouring too cool. The same cause makes the castings leaky as liquids under pressure ooze through the green places, as the latter are dross, not metal. We do not approve of the spray of linseed oil and kerosene, as this will prevent fine colors being obtained on the castings. It would be better to dust on flour, blow it off, then again dust and blow off. As shown by the fractures the metal mixture appears to be a poor one, too high in zinc, and low in lead for such work.

Gives Bearing Alloy

What bronze alloy would you recommend for an extra heavy crane bearing 4½ inches bore by 7⅞ inches long. Our standard mixture is 80 per cent copper; 10 per cent tin and 10 per cent lead, with a little phosphor copper added, but we also make gun metals and United States Navy composition, H., and are wondering if the last two alloys would stand up better in extra heavy service than bearings made of phosphor bronze.

We feel the 80-10-10 mixture would be the best for such a bushing, but should there be any doubt about it the following alloy will give good service: Copper, 88 per cent; tin, 8 per cent; lead, 4 per cent. This alloy has been found suitable for use in connection with heavy board drop hammers, and no doubt can be used with confidence for the crane bushings mentioned.



Bill Figures Weight of Round Castings

By Pat Dwyer

BILL is not one of these sophisticated people who refuse to visit a circus on the lofty ground that once you have seen one you have seen them all. He takes the commonsense view that one might just as well talk about refusing to take a bath at periodic intervals or abstain from food forever after enjoying one hearty meal. Probably, even if he had the opportunity, he would not go to see a circus every week, but since Providence in its inscrutable wisdom has decreed that a circus only comes to town once a year Bill's appetite is whetted to a point where he can enjoy the show thoroughly. Several members of his family have arrived at a stage where they can take care of themselves and buy their own tickets, but a few still are small enough to hold him by the hand and intensify his enjoyment by going into raptures over the spectacular performance. He does not assume the somewhat modern role of bored indifference and thus dampen their childish ardor by pretending that parental duty alone impels him to make the sacrifice. From the first day the gaudily colored posters appear on the billboards until the great day finally arrives he is as keenly interested as any of the junior members in the Marvellous, Miraculous, Mastodonic and Meteoric features that are to be presented for the edification and enjoyment of the populace. Bill was born several centuries too late. If there is anything in the theory of heredity and reincarnation then most assuredly at a remote period one of Bill's ancestors was a dyed in the wool fan at the sprightly and exhilarating contests of skill and endurance pulled off on festive occasions in that famous old athletic establishment, the Roman Coliseum. The original Bill ruffled it with the best of them. He cocked his bonnet, munched peanuts and hot dogs, drank immense quantities of pop and hurled the empty bottles with great gusto into the arena. Invariably when the victorious gladiator glanced upward to the sea of faces seeking a verdict whether his adversary should live or die the original Bill's big red thumbs cheerfully were turned down.

In the centuries that have elapsed since those brave days of old (See Horatius at the bridge) fashions in amusements have changed and the modern Bill has adapted himself to the changed conditions. Many years ago he worked in Mexico and was a devoted patron of the bull fights. He still speaks occasionally with respect and admiration, slightly tinged with regret, of the many pleasant hours he spent in this manner. He is a baseball enthusiast, he attends the races and whenever and wherever two of our justly famed athletes enter the ring with the laudable intention of pounding each other to a pulp for honor and glory and a slight honorarium, Bill is there in a front seat.

He was not quite through serving his apprenticeship when the world's fair was held in Chicago. He lived at the time on the Atlantic seaboard and he had no money, but he did not allow these trifling features to prevent him from seeing the show. He tried to persuade me to accompany him, but at that time I did not have the abounding faith which enables men to travel long distances with no more negotiable resources than an unlimited supply of nerve. I meandered around to some extent later, but that is another story.

Bill pointed out logically, if not convincingly, that LaSalle, Joliet, Marquette and perhaps dozens of other hardy adventurers had penetrated as far as the site of Chicago and farther, hundreds of years before, when neither railroads nor highways existed. If they could do it under primitive conditions and in a hostile Indian country he foresaw no difficulty in making the journey over a civilized route. Convenient freight trains were available almost every hour of the day and night and he felt he could rely on the boundless hospitality of the inhabitants en route to furnish an occasional handout. So far as I have observed up to the present, the city of Chicago has not seen fit to erect a suitable monument in any of the city parks or along the Boul' Mich' to commemorate his arrival. Nevertheless and notwithstanding he arrived in the town in fine trim, landed a job for himself in the Illinois Steel over in South Chicago and in his spare time strained his eyes and ears to the elastic limit in absorbing every legitimate and perhaps a few illegitimate features of the big show. Several years of promiscuous wandering

THE GLADIATOR STRUTS HIS STUFF

brought him into Buffalo in time for the Pan-American exposition. During legitimate working hours he juggled the bricks and mud *under de hook, kid,* in the Snow Pump, but on Sundays, holidays and other periods of leisure he did his best to see and hear all there was to be seen and heard at the exposition. To his everlasting credit be it said he was not present when President McKinley was shot. At one time or another I have talked with hundreds of people who were in Buffalo at the time and without exception they all claim they witnessed the tragedy. I am sure you will agree with me the circumstance seems extraordinary. Apparently Bill was the only man in Buffalo at work on that day and therefore prevented from witnessing the dramatic tragedy. A few years later Bill worked his way by easy stages up the Mississippi from N'Orleans and, as he says, *caught* a job at the Fulton in St. Louis. He was all set and sitting pretty on top of the world when the world's exposition opened in that city. He was married by this time and the fair furnished an exceedingly colorful background for a long drawn out honeymoon. Looking back at it now he claims and without exaggeration the St. Louis fair was the best of them all. Mrs. Bill is not so enthusiastic. She tried her first housekeeping venture there and when Bill decided to pull up stakes after the fair was over she had to break up and start again elsewhere.

Family responsibilities and one thing and another—good old phrase, one thing and another, it covers a multitude of bills—kept him anchored for longer periods than those to which heretofore he had been accustomed, but like the well known star of empire he edged gradually westward and was Johnny-on-the-spot when San Francisco staged her famous exposition in 1915.

About a year later Bill accepted a responsible position in the east and has been here since that time. East is only a relative term. From the Pacific coast standpoint this is the east, but people residing along the Atlantic coast refer to Cleveland as a western town. It is a nice point. Perhaps some day after the government has decided whether we are wet or dry a commission or a board will be appointed to settle the question.

When the first rumors of the Sesquicentennial exposition in Philadelphia came trembling over the wires about a year ago, Bill's feet began to itch and he threw out a few tentative hints about looking for a job down in that vicinity. Mrs. Bill promptly said *NO* in a loud voice. She said she had all the gypsy life she wanted. Here she was and here she intended to stay. If Bill wanted to go galivanting over the country that was his privilege, but she begged to remind him to mail her his pay check every month as usual. She would be pleased

WILLIAM
TWO FLAT TIRES AND A FLAT POCKET BOOK SAY WHERES THA BEST PLACE TO COMMIT SUICIDE AROUND HERE HUH?
TO DETROIT FOUNDRY CONVENTION SEPT 27-OCT1
RICHEY

ALL HE CRAVES IS A LITTLE SYMPATHY

to remit him enough to keep body and soul together until such time as he saw fit to return.

In the foundry Bill is supreme. He says to this man to go and he goeth and to that man to come and he cometh, but through long years of experience he has learned to walk warily in the presence of the high justice, the middle and the low. He knows when and where to roar like a lion, but he keeps the old soft pedal oiled and in good working order to be clapped on when he crosses the family threshold—even as you and I.

However, through a natural gift cultivated to a high state of perfection he has become an adept in disposing of the proverbial cat when the obvious and standard choking-with-butter method has failed. In the present instance he waited until his vacation period drew near and then intimated casually one night that it would be a good plan to load the family into the car and drive to Philadelphia for a week or two. Somewhat to his surprise Mrs. Bill fell in with the plan without a single objection. Later to his dismay he learned the reason. She had accepted the proposal as an invitation to go out in the busy marts of trade to buy about a million dollars worth of clothes for herself and the children. Bill may have exaggerated the sum slightly. I merely am repeating what he told me. When he inquired mildly why she wanted all the clothes to go for a bit of a drive she informed him graciously she did not propose to spend all her time in the machine. Further, she had no intention of poking around Philadelphia looking at a silly old exhibition. She might stop one day, but the remainder of the time she intended to live at one of the hotels in Atlantic city. As you might say in a manner of speaking, that was that.

They returned the other day and Bill came around last night to smoke a pipe with me on the veranda. To my casual inquiry regarding the trip he said never again unless some fairy godmother left him a fortune and that was something he never expected.

"When I was a young gaffer," said Bill, "I read a story about a guy named Aladdin who had a magical lamp. Each time he wanted anything he rubbed the lamp and the slave of the lamp appeared on the scene to get him anything he asked for. Believe me, young feller-me-lad, Aladdin would have kept that gink hopping if he had to live in Philadelphia this summer. He would have worn the old lamp down to a point where a junk man would not have accepted it as a gift. He could have crumpled it in his hand like a cigarette paper. There would not have been enough of it left to make a puff of smoke if he had thrown it into a cruicible of metal. Magical lamps are magical lamps, but they have a limit.

"Don't let any person tell you that Philadelphia is a sleepy old town. It may have been sleepy at one time when it was inhabited by William Penn and a handful of honest old Quakers. Then a man could put up at Ye Sign of Ye Bull, leave his saddle bags in safety on the floor all night, pay his modest score in the morning and depart in peace.

"If he gets away now with the fillings intact in his back teeth he is lucky. Ye Olde Bull Inne has disappeared and the modern hostelries rejoice under more euphonious titles. In the olden days the inn keepers used

the bull for a sign. Now they shoot it.

"The avidity and skill displayed by some of the modern Philadelphia race of inn keepers in making hay while the sun shines might lead one to the conclusion that they were descended from agricultural forbears. Recent experience inclines me to the opinion that the second half of the word is the only part applicable, except possibly with the prefix grizzly. In fact I doubt if any grizzly bear that ever lived could toss a man up, shake him down and clean him out as neatly, quickly and thoroughly as one of these civilized marauders. The exhibition may show a deficit, but some of the hotel owners of Philadelphia easily can afford to hibernate for the winter.

"The exhibition is immense and I enjoyed the visit thoroughly, even if it did flatten me out financially. However, I have been flattened out before on many occasions and while the experience at times has been painful, up to the present it has not been fatal. By exercising rigid economy and existing on a frugal diet of bread and water I probably will be able to win through the winter. A visit to any town would not be complete unless I saw a few foundries. Many years ago I worked in one of the big shops there and on this occasion I rambled in on the off chance that I might meet some of the lads I knew. Every one was gone but the old gaffer. After I established my identity he was quite friendly. I remembered him easily because he at one time had shown me how to figure the weight of cylindrical castings. I was making a mold for a casting 35 inches diameter 13 inches high with an 11-inch hole.

"He explained that two methods are available for finding the weight of cylindrical iron castings. The first is the standard method of calculating the cubical content in inches and multiplying the result by 0.26. This decimal represents the weight of one cubic inch of cast iron as part of one pound. It is apparent that if the total number of inches in the casting is multiplied by 0.26, the result will indicate the weight of the casting in pounds. The rule for finding the cubical contents of a cylindrical body is to square the diameter, multiply the result by 0.7854 and then multiply the final result by the height. In this particular casting the formula may be set down as: 35 × 35 × 0.7854 × 13 = 12,506 cubic inches. When this is multiplied by 0.26 thus: 12,506 × 0.26, the result is 3251 pounds, the weight of a solid block the size of the casting. Perhaps this will be more apparent if the different steps are shown in detail.

35	1225	962	12506
35	0.7854	13	0.26
—	—	—	—
175	4900	2886	75036
105	6125	962	25012
—	9800	—	—
1225	8575	12506	3251.56
	—		
	962.1150		

The figures 1150 appearing after the decimal point at the bottom of the second item have been omitted from the top of the third item for the sake of convenience and because they do not affect the total to the extent of more than 1 or 2 pounds.

FRIENDS ARE SO FREE WITH ADVICE

Subtract the Opening

The foregoing weight, 3251 pounds represents a solid block of iron of the dimensions indicated. The volume of the opening left by the center core must be estimated and subtracted. This may be done by assuming that the core is a solid block of iron and is removed from the casting after it has been poured. The weight of the block may be found in the manner employed for finding the weight of the entire block. Thus: 11 × 11 × 0.7854 × 13 × 0.26. Without going through the detail it may be stated that the result is 321 pounds. By subtracting 321 from 3251, the weight of the casting is found to be a net amount of 2920 pounds.

This method, as will be noted, gives a close figure for the weight. Perhaps the detail required may be too minute for all practical shop purposes.

The second method is simpler and therefore more rapid. It is based on the fact that if the area of a circular plate measured in inches is multiplied by the constant 0.206 the result will show the weight of a plate 1 inch thick in pounds. Evidently when the weight of a section 1 inch thick is known the total weight easily is found by multiplying the weight of the 1-inch section by the number of inches in the height of the casting. In the problem presented for solution the figures will be set down as follows: 35 × 35 × 0.206 × 13 = 3280 pounds. From this is to be subtracted the weight of a block corresponding to the size of the core. This weight is found in the same manner, 11 × 11 × 0.206 × 13 = 324 pounds. The weight of the casting by this method is 3280 — 324 = 2956 pounds. This is slightly more than the weight given by the other method, but it is sufficiently accurate for ordinary foundry calculation. After I had learned my little lesson I derived a considerable amount of pleasure from figuring the weight in advance of all the castings I had to make and later checking the weights in the cleaning room. Naturally I though that others with whom I worked would be similarly interested. I was somewhat surprised to find that not a single man cared how the job was done. Later in many places I found that this attitude prevails almost universally. The majority of men entertain the comfortable view that figuring the weight is part of the old man's job and they are quite satisfied to let him worry over it. They are like the man who asked his friend how to kill a cat. 'Ah!' said the friend carelessly, 'Just grab him by the tail and that will be the end of him!'"

Appoints Sales Managers

William MacGregor and S. F. Courter have been appointed general sales managers, each in charge of a sales division of the Carborundum Co., Niagara Falls, N. Y., succeeding to the work of the late William W. Sanderson. George R. Rayner will continue as vice president in charge of sales. Mr. MacGregor and Mr. Courter will be his assistants. Mr. MacGregor formerly was sales manager of the coated abrasive division of the Carborundum Co. and Mr. Courter had been a district sales manager of the office, warehouse and sales force in Philadelphia. He is succeeded there by W. J. Griffith.

Nickel Affects Gray Iron

Conclusions Based on Series of Tests Show the Effect of Nickel and Chromium in Varying Proportions on Gray Iron Castings

By T. H. Wickenden and J. S. Vanick

BELOW about 4.00 per cent, nickel does not affect total carbon to any practical extent. At 5 per cent it begins to decrease it slightly. Nickel accelerates graphite formation and carbide decomposition and therefore exercises a marked influence in reducing combined carbon to about 0.8 per cent, the eutectoid ratio, but acts only mildly, apparently, to reduce it below this value. This effect of nickel is roughly proportional to the amount of the nickel addition and is most prominent where the nickel content is 1.00 per cent or over.

Due to the active influence of nickel in breaking down carbides, the hard constituent of white iron, it is effective in reducing chill and preventing the formation of white or mottled iron or hard spots, particularly in thin sections, at edges, corners, etc. This effect is quite positive with 1.00 per cent nickel or more and generally is found with smaller amounts down to about 0.25 per cent.

Chromium addition always tend to increase chill and combined carbon, and the iron with increasing additions tends to become white, mottled, hard and brittle, particularly at edges or corners. The presence of nickel restrains this effect of chromium, except that, curiously enough, small additions of nickel (0.25 per cent or less) appear actually to intensify the chilling effect of small amounts of chromium.

Reduction of chill is one of the most useful functions of nickel in iron, since it serves to eliminate hard spots in casting of thin or variable section and thus renders them tougher, less fragile and more readily machinable.

Apart from their effect on chill, nickel and chromium, alone or in combination, both serve to refine the grain of gray iron and this effect is obtained with relatively small amounts; viz., 0.15 to 3.0 per cent. With larger additions of nickel, 5 to 10 per cent, the grain again is coarsened and made more open.

Nickel encourages the formation of a cellular pattern, during solidification, within which graphite, ferrite and pearlite or sorbite are finely divided. Chromium assists in the development of this structure if the silicon is high. Excessive amounts of chromium (over 0.50 per cent) produce a second and coarser network of residual cementite superimposed on the first. This cementite network will promote brittleness and may develop machining difficulties or accelerate wear. Nickel in the proper ratio to chromium, from 3 nickel to 1 chromium in low silicon iron to 3 nickel to 2 chromium in high silicon iron, serves to destroy the cementite network in either plain or chromium-rich irons. It improves their structure and adds desirable properties such as greater toughness, a solid solution hardness, improved strength, uniform machinability and greater wear.

Use Alloyed Cast Iron

NICKEL and nickel-chromium cast irons are being used commercially for purposes where strength is required. The principal effects of these metals on cast iron is given in this article which is abstracted from a paper presented before the Syracuse convention of the American Foundrymen's association last fall. The authors, T. H. Wickenden and J. S. Vanick are connected with the development and research department of the International Nickel Co., New York and Bayonne, N. J.

Effect On Hardness

Chromium additions, always increase the hardness of gray iron causing it to become white or mottled or at least to increase its combined carbon. Decrease of silicon or total carbon content or increase of sulphur content will accomplish a similar change.

Nickel additions from 0.25 to 5.00 per cent also produce a substantial hardness increase in gray iron ranging from 10 to 100 points Brinell depending on section and silicon of the casting.

Increase of hardness by nickel is of a totally different nature, to that obtained by addition of chromium or by variation of silicon, carbon or sulphur content. The iron is not thereby chilled nor is its combined carbon increased (usually with consequent machining difficulties), but that portion of the iron already combined with carbon (the pearlite) is rendered naturally and uniformly harder sorbite. This is the reason iron can be hardened with nickel additions an yet be as readily machined as in the softer condition.

Hardening effect of nickel is somewhat dependent, on the amount of combined carbon in the casting and the most favorable results usually are obtained when this amount is not too low, preferably not below about 0.50 per cent.

Machinability of gray iron depends primarily on its freedom from excess carbide, chilled or hard spots. Since nickel tends to eliminate these carbide areas it definitely improves machinability of iron subject to them. One per cent, and often less, of nickel usually is effective, depending upon the section, the silicon and carbon content and the amount of chromium also present.

Corresponding to the effects of nickel and chromium in refining the grain and in increasing the hardness of iron are similar effects of these alloys in increasing the strength—compressive, tensile and transverse—the increases amounting to from 10 to 50 per cent.

Development of increased strength requires different amounts and even ratios of the two alloys for different compositions of iron and for different sections of castings. This is illustrated by Table I giving arbitration bar results on two different grades of iron.

Action of nickel alone in increasing strength is dependent upon the presence of a reasonable amount of combined carbon, preferably as high as possible up to about 0.80 per cent, the eutectoid ratio, and not lower certainly than 0.50 per cent if substantial increase are sought. Nickel itself does not increase combined carbon and in castings carrying small amounts of combined carbon produces only small strength increases.

Therefore, in iron compositions which, by reason of high silicon or total carbon content, usually show a low combined carbon and less than the limits cited, some other means should be taken at the same time to raise this combined carbon.

An excellent means is the simultaneous addition of chromium. This is one reason that for many compositions of iron, nickel and chromium additions together will produce strength results superior to either of these alone. In this case the two elements function differently but in a supplementary manner.

Another method is the simultaneous reduction of silicon content, allowing the nickel to substitute for silicon in eliminating excess carbide. By this method cheaper irons or scrap often may be used partly offsetting the cost of the nickel.

Generally speaking, to secure substantial strength increase on arbitration bars the following additions are suggested for irons with the indicated silicon:

Silicon Per cent	Nickel Per cent	Chromium Per cent
1.50	0.75-1.00	0.00-0.25
2.00	0.75-1.00	0.20-0.45
2.60	0.75-1.00	0.40-0.50

The amounts of chromium shown may be decreased for thinner sections.

Effect on Toughness

Nickel definitely improves the toughness of iron as measured by transverse deflection or other methods. The improvement is most prominent with higher nickel additions, from 3 to 5 per cent, and in thinner sections. Thus increases in deflection of 100 per cent and consequently in toughness can be obtained in ⅛ inch to ¼ inch sections by the addition of 3 to 5 per cent nickel. This of course partly is due to the powerful action of nickel in eliminating excess carbides or hard and mottled corners and edges.

Even in iron (particularly in thin sections), which without the nickel usually is gray and free from chill, the addition of nickel further increases deflection and toughness. No explanation is yet available for this definite effect. In cases where chromium also has been added to further improve strength, the nickel will serve to improve the deflection or toughness which often is impaired by the presence of the chromium.

Shrinkage in solidification leading to internal porosity is not increased by the presence of nickel (below 5 per cent), but in the higher silicon gray irons which suffer from shrinkage, suitable additions of nickel or nickel and chromium will reduce and actually may eliminate it.

Nickel and chromium additions up to 5 per cent and 1 per cent respectively exercise no effect on contraction of gray iron and usual pattern allowances are quite sufficient.

The fluidity of gray cast iron is not changed by the presence of nickel up to 5 per cent or of chromium up to 0.50 per cent, or by combination of the two within these limits. These tests have demonstrated the substantial effect of a slight decrease in total carbon or of a temperature lowering by as little as 100 degrees Fahr., in increasing the sluggishness of the iron whether or not it contains alloys.

Some of the present typical commercial uses of iron alloyed with nickel or nickel chromium are shown in Table II. Suitable nickel and nickel-chromium additions to cast iron may be made to serve the following purposes:

Increase transverse, tensile and compressive strength in all sections. Increase toughness and decrease fragility, particularly in thinner sections. Eliminate hard spots and improve machinability particularly in thinner sections. Increase hardness without impairing machinability. Equalize hardness in sections of different dimensions increase resistance to wear of machined or machinable surfaces. Secure maximum hardness, uniform and machinable. Reduce and regulate chill. Secure fine-grain dense castings or surface for polishing. Secure resistance to oxidation and scaling at high temperatures. Secure resistance to corrosion. Reduce shrinkage and porosity in certain cases.

Hardness May Be Increased

As the nickel content of cast iron is increased to any point between 5 and 12 per cent a series of alloyed irons may be produced which are martensitic and quite hard, particularly if chromium also is present. Thus an iron carrying 4.70 per cent nickel 0.70 per cent chromium and 3 per cent carbon showed a brinell hardness of 578 on the 1¼-inch section.

As the nickel is increased beyond 15 per cent the hardness drops and the iron is austenitic, but the iron generally remains quite tough and flexible. It becomes quite resistant to corrosion.

For many special purposes the unusual properties of these higher alloy irons should prove valuable.

H. G. Steibrenner has been elected second vice president of the Brown Hoisting Machinery Co., Cleveland, and will have charge of sales.

Table II

Typical Uses of Nickel and Chromium

Article	Alloy	Reason for Adding Alloy
Thin section resistance grids	5 per cent nickel	To improve toughness
Thin section piston rings	1-3 per cent nickel	To improve toughness, machinability and resistance to wear
Pistons	¾-1½ per cent Ni.	To improve machinability and resistance to wear
Automobile cylinders and sleeves	Ni. 2 per cent Ni. 1.0 per cent Cr. 0.3 per cent	To improve density and resistance to wear
Cams	3 per cent nickel	To secure maximum hardness still machinable
Rolls	1.50 per cent Ni. 7.5 per cent Cr.	To secure strength, toughness
Pipe-balls	1.50 per cent Ni. .75 per cent Cr.	To secure resistance to scaling at high temperatures
Forming dies	1.00 per cent Ni. .40 per cent Cr.	To secure strength and toughness

Table I

Silicon Content Affects Strength

			Iron with 1.40 per cent silicon		Iron with 2.70 per cent silicon	
Nickel per cent	Chromium per cent	Combined carbon per cent	Transverse strength pounds	Deflection in inches	Transverse strength pounds	Deflection in inches
0	0	.72	3390	.132		
1.23	.10	.62	4510	.142		
1.10	.51	.80	4770	.142		
0	0	.44			2930	.128
.67	0	.44			3170	.138
.85	.59	.64			3980	.110

Setting Overhanging Core *Simplified*

Through Practical Methods

BY H. N. Tuttle

OVERHANGING core is the name usually applied to a core where the print overhangs, or projects beyond the body of the core. A familiar example is that used on the larger sizes of gas engine pistons. This type of core is used considerably for coring out covers, cases and other box or basin shaped castings. This core was popular a few years ago, and although it has lost much of its popularity, it still is commonly used. When the metal is thin, with deep walls and little draft, it is almost impossible to obtain perfect castings with the standard equipment for this type of core.

If the walls are thin and deep, and with little draft, it is practically impossible to set the core without shaving, since the molder cannot see the core entering the mold because of the overhanging print. Of course, a thick core print, equal in thickness to the depth of the mold proper, and with slightly less draft, would take care of this core setting trouble, but this would be unreasonable due to the extra cost and weight.

Fig. 1 shows a guide core method of setting this core, where the core, *A*, is used to guide the setting of the main core, *B*, into the mold. The guide core ordinarily is made about 1 inch thick, and has a hole through the center which makes a close sliding fit over the main core. It is not advisable to make the core, *A*, an exact or tight fit in the mold, but a little clearance, as shown at *C*, should be left for adjustment of position of this core after being placed in the mold. This is necessary because in ordinary production work, some variation will be found between different cases which are made in the same box.

To obtain the exact location for the guide core, *A*, a wood gage similar in shape to a core arbor is set into the mold, after core, *A*, is set. The exact metal thickness at all desired points now can be seen at a glance, and the guide core adjusted accordingly. After the core, *A*, is located correctly it is tucked around the outside to hold it in place.

The main core now may be let down through the guide core without danger of shaving, and the assurance that it is properly located.

The core gage for locating the guide core is just the shape as that obtained by making a plaster of paris core, *B*, and then sawing away surplus plaster, until bars, similar to flask bars, remain on various center lines as shown in Fig. 2. The gage readily may be made by fitting wood bars in the main corebox, *B*.

To make sure that the core, *B*, has not become incorrectly shaped from settling in drying, tipping over, from being rapped too much, etc., each core should be gaged before leaving the coreroom. A gage for this purpose is merely a mating gage built over the first gage with a slight extra allowance for the unavoidable core variations. The core, *A*, should be slipped over *B* and tried for fit before being delivered to the molder.

Another way of setting these difficult cores is by sliding them down a gage, which accurately is located on the mold by ears which fit over the flask pins. Fig. 3 shows a gage designed for this purpose. It is made in the form of a frame larger than the outside of the overhanging coreprint, with ears to fit the flask pins. Four machined right angle guide brackets, *AA*, for guiding the core down into the mold are bolted on the frame. These guide brackets extend down into the mold to a depth nearly equal to the thickness of the overhanging print, *BB*. After the core is set, and before removing the gage the core is tucked firmly in position

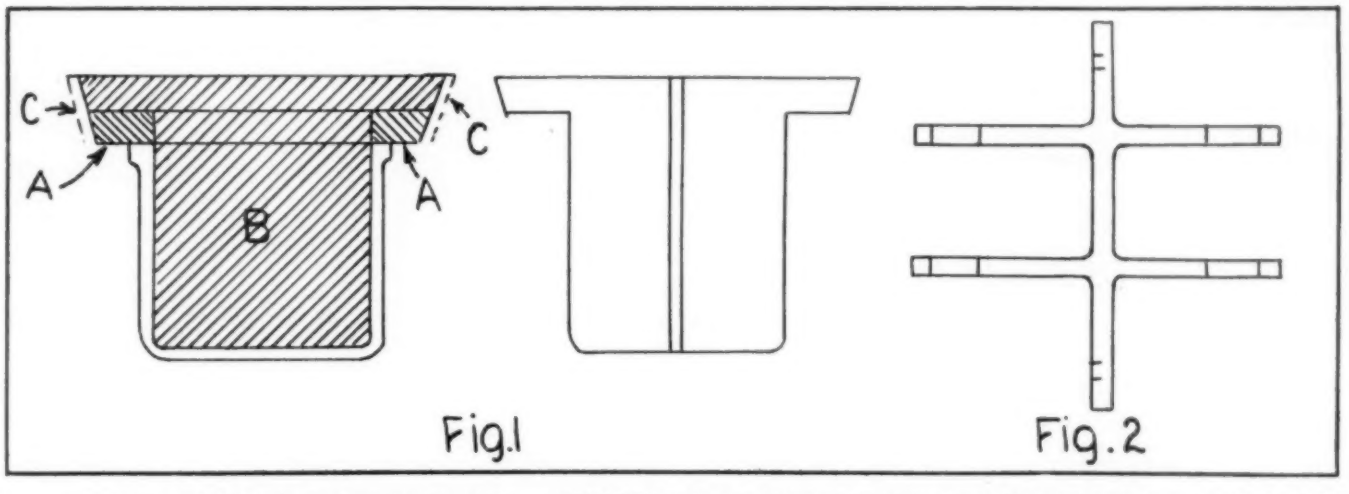


FIG. 1—GUIDE CORE METHOD OF SETTING CORES. A SMALLER CORE IS USED TO GUIDE THE MAIN CORE INTO THE PROPER POSITION. FIG. 2—A GAGE OF THIS TYPE IS USED TO LOCATE THE GUIDE CORE

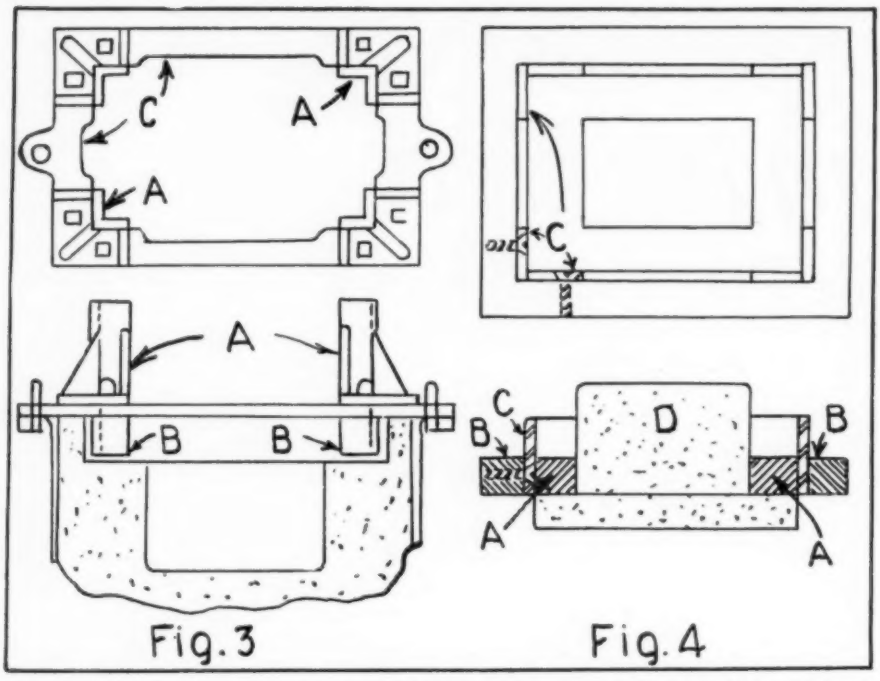


FIG. 3—EARS THAT FIT OVER THE FLASK PINS SERVE TO HOLD THE GAGE IN PLACE WHILE THE CORE IS BEING SET. FIG. 4—AN EASILY MADE GAGE OF THIS KIND IS USED TO CHECK THE CORE BEFORE REMOVING TO THE MOLD

through the cut outs at *C*, on four sides. The lower ends of the angle guide brackets hold the core firmly in place at the corners while the coreroom by another set of gages shown in Fig. 4. *D* shows the core, upon which the cast iron frame, *A*, is set. This frame is a perfect fit to the body of the core on the inside, while the outside, at the corners also is a perfect fit to the angle guide brackets of the setting gage, Fig. 3. *B* is another frame which slips over *A*, and fitted perfectly at its corners by the hardened steel angles, *CC*. By pushing this outside frame, *B*, down over frame, *A*, the hardened angles, *CC*, shear off the four corners of the core to a perfect fit.

To use this kind of gage, the pattern has to be mounted on a pattern plate, with pin holes properly located, that the flask and mold always will be located properly with reference to the flask pins.

If it is desired to use this type of gage with a loose, hand pattern, an auxiliary wood gage has to be used. This is shown in Fig. 5, in which *AA* is a section of the standard core setting gage shown in Fig. 3. *B* is a wood frame which fits into *A* and is located snugly by lugs *CC*. At *DD* the frame drops down within 1/32-inch of the edges of the mold proper and is made in such shape that when frame, *A*, properly is set, the inside edges at *DD* will coincide exactly with the inside edge of the mold. After the frame, *A*, is lined up in this manner, the wood gage, *B*, is removed and the core set as in the previous case.

It is essential that the core be lowered in a perfectly level position when the metal is thin. Two 10-cent store levels, fastened as in Fig. 6 will be of great assistance in keeping the core level while lowering.

When an overhanging core is quite heavy yet not heavy enough to lower with a crane, and especially when the core hook anchors are not located in a good balancing position, it is incon-

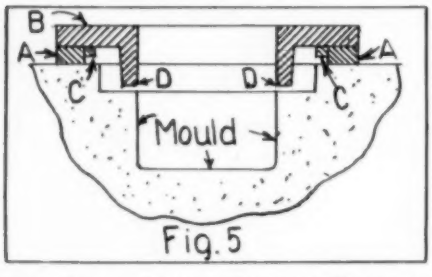


FIG. 5—WITH LOOSE HAND PATTERNS AN AUXILIARY WOOD GAGE MUST BE USED

sides are being tucked by the molder.

To insure the core being a perfect fit to the core gage, it is fitted in the

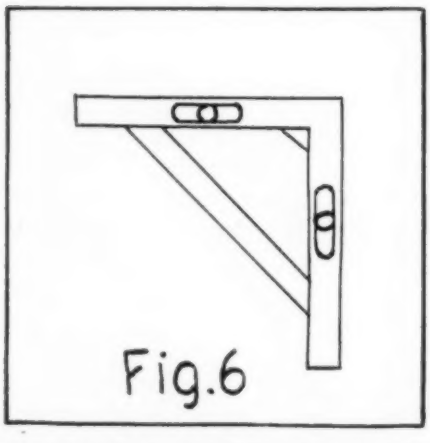


FIG. 6—INEXPENSIVE LEVELS ASSIST IN KEEPING THE CORE LEVEL DURING SETTING

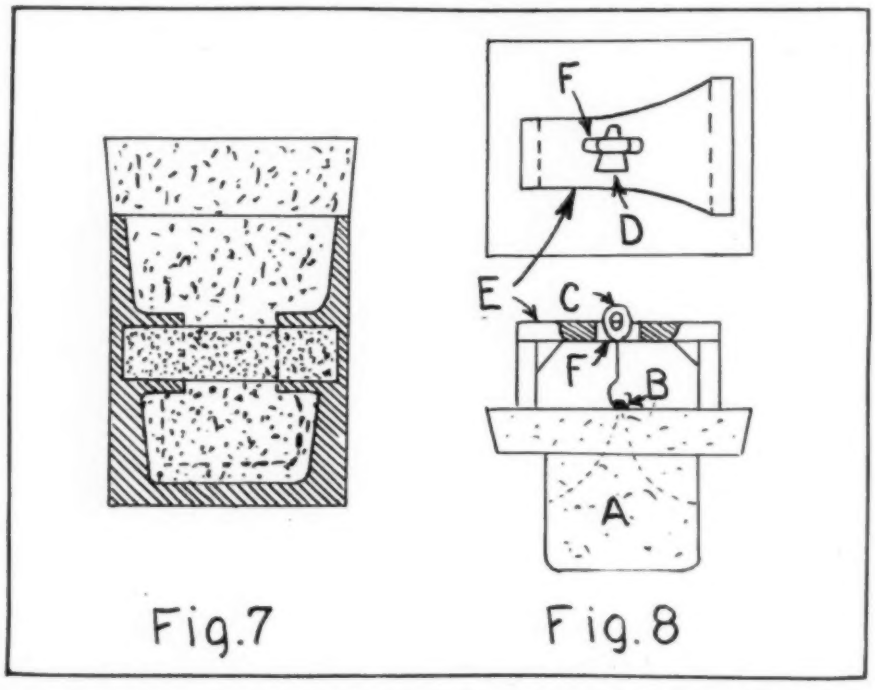


FIG. 7—VARIATIONS IN WALL THICKNESS ARE ELIMINATED BY PLACING THE CORE IN THE PATTERN SIMILAR TO A RAM-UP CORE. FIG. 8—THIS CLAMP MAY BE USED WITH MODERATELY HEAVY CORES OR IN CASES WHERE ANCHOR HOOKS ARE PLACED INCONVENIENTLY

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in notebook form.

TENTATIVE SPECIFICATIONS FOR 88-8-4 SAND CASTINGS

(*Continued from Data Sheet No. 634*)

III. PHYSICAL PROPERTIES AND TESTS

5. (*a*) The alloy shall conform to the following requirements as to tensile properties:

(*b*) The yield point shall be determined as the stress producing an elongation under load of 0.5 per cent, that is, 0.01 in. in a gage length of 2 in.

Tensile strength, min., lb. per sq in	40 000
Yield point, min., lb. per sq in	15 000
Elongation in 2 in., min., per cent	20

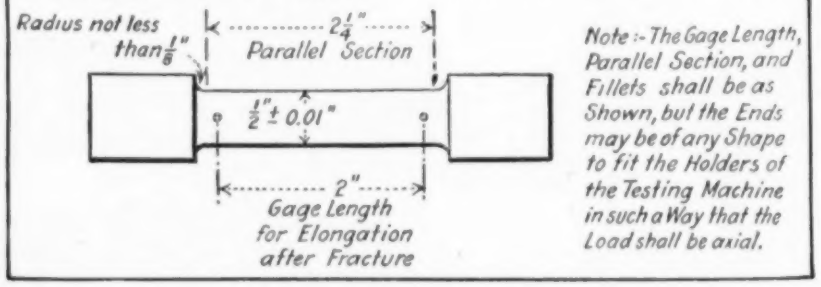

Radius not less than 1/8"
2 1/4"
Parallel Section
1/2" ± 0.01"
2"
Gage Length for Elongation after Fracture
Note:-The Gage Length, Parallel Section, and Fillets shall be as Shown, but the Ends may be of any Shape to fit the Holders of the Testing Machine in such a Way that the Load shall be axial.

FIG. I. TENSION TEST SPECIMEN

(*c*) Castings made from this alloy shall conform to such requirements as to pressure tests as mutually may be agreed upon between the purchaser and the manufacturer and as specified in the contract or purchase order.

6. (*a*) The tension test specimen shall be machined from a coupon to the dimensions shown in Fig. 1. The ends shall be of a form to fit the holders of the testing machines in such a way that the load shall be axial.

(*Continued on Data Sheet No. 636*)

TENTATIVE SPECIFICATIONS FOR 88-8-4 SAND CASTINGS

(*Continued from Data Sheet No. 635*)

(*b*) The coupon attached to the casting shall be in accordance with the dimensions shown in Fig. 2. The fin gate along the side shall be not less than 5/16 in. in thickness at any point along its length.

7. (*a*) Each casting weighing 250 lb. or more shall have, if practical, at least

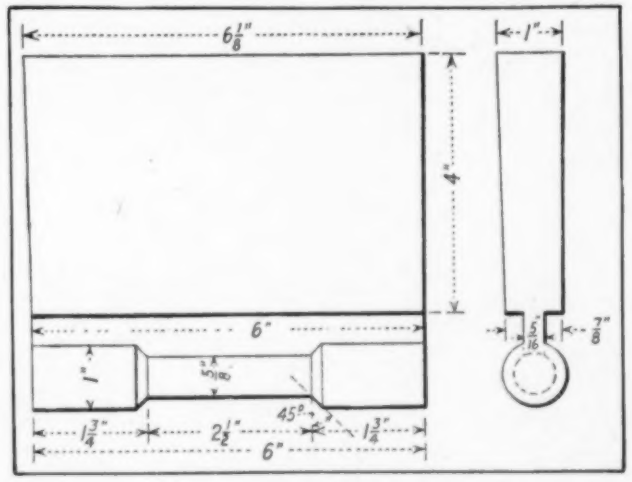


FIG. II. TEST SPECIMEN COUPON

one test coupon attached. The responsibility of furnishing sufficient test specimens shall rest with the manufacturer.

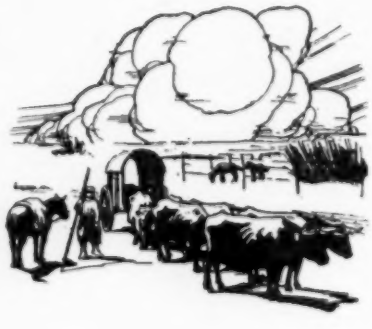
(*b*) In the case of castings weighing less than 250 lb. each, at least one test coupon shall, if practical, be attached to one or more castings from each melt or heat or from such groups of melts or heats as the purchaser may specify, but in no case shall a lot consist of more than 1000 lb. of castings.

(*Continued on Data Sheet No. 637*)

Around the World with The Foundry

Little Journeys to the homes of our readers

Uruguay



OVER an area 120 miles wide and for a distance of 60 miles out to sea, the rolling brown flood of the Rio de la Plata, driven in an unbroken stream until it loses its identity in the long, undulating swells of the South Atlantic, contains waters from the immense territory drained by the Parana and the Uruguay river and—where it flows through the estuary of the Plate—is recognized as the official boundary between Uruguay and its important neighbor, Argentina.

Hustling, alert, breezy, this smallest of the South American republics tucked snugly away between large and powerful states north and south, more nearly approaches northern countries in its habits and customs than any other in the group making up the southern half of the American continent. Cattle and sheep from an apparently inexhaustible source on the rolling uplands, flow in a steady stream to the great packing houses in the coast cities where they are converted into wool, hides, tallow, salted and frozen meat to be shipped to the four corners of the earth. Nearly all the machinery required in the packing and agricultural industry, is imported, but several iron and brass foundries are in existence and recently a converter steel foundry has been placed in operation by the government. In three of the principal casting plants THE FOUNDRY keeps the executives posted twice a month on current practice and recent development in the industry.

"Wherever metals are cast you'll find THE FOUNDRY"

venient to handle them. Fig. 8 shows a clamp which easily is made and convenient. *A* shows the core with the hook anchor at *B*. *E* is a frame or stand made of three boards, with a slot, *FF*, in the top member. The hook, *C*, is slipped through this slot and wedged tightly in place by wedge, *D*. Using this as a handle, the core easily may be lowered to position without the fingers being in the way of the mold, and no trouble will be experienced in balancing the core.

Even when the overhanging core properly is located, care must be exercised to keep it in position. If a cope is used, it is essential that the thickness of the print be correct. If too thick the cope will cause the core to crush the mold. If too thin, the iron will raise the core, increasing the bottom metal, and possibly shifting it. In case no cope is used, great care has to be exercised in clamping the core, as one side is liable to be clamped down more than the other, causing a tilting of the core, a crush by clamping too tightly, or a raise by not clamping tightly enough.

The overhanging core has been used much in the larger sizes of gas pistons. Also, a great deal of trouble has been encountered from varying wall thickness. A method of eliminating this which has been successfully used is shown in Fig. 7. The core is set in the pattern, similar to a *ram up* core. It is placed in the pattern before the sand is rammed. This insures the core being properly in the mold. While there is some danger of variations in wall thickness due to poor fit of core in pattern, incorrect corebox, shifting of the core by pouring pressure of the iron, or by being clamped over by improperly bedded or warped bottom-boards, the chances of even metal thickness are much greater by this method than by the overhanging print method. Experience also has proved this to be the case.

However, a place where the overhanging print is used with signal success, is in assembled cores, where several cores are fitted into an overhanging print, and the whole assembly set as one core. Gas cylinder-head cores and the like can be handled in no other way as conveniently as this. The cores are assembled in the coreroom, where the metal allowance easily may be seen and gaged, and all the dirt blown out before being taken to the mold. Since the pressure of the iron is upward, it has no tendency to move the cores out of place.

American Steel Foundries has removed its St. Louis offices to 1717 Railway exchange building

Small Castings Shrink

Question: We are forwarding for your inspection a small cast iron disk 3½ inches diameter, 1-inch thick with a projection ½-inch deep and 2 inches diameter on one side. A hole 1⅜ inches diameter is drilled through the center. These castings are machined all over and we find cavities under the skin in the angle formed by the projection with the main body. We shall appreciate your suggestion on how to prevent this trouble.

Answer: We should be in a better position to diagnose the case if you had forwarded a casting in the condition it left the mold. Your trouble may be due to one of several causes, but on general principles we are inclined to the opinion that it is caused by pouring the castings solid, in a shallow flask with small gates.

You did not state which side of the casting was molded in the drag, how many patterns on a gate, or whether the center was cored or cast solid. A knowledge of these factors is required to draw an intelligent conclusion.

We suggest you mold the casting with the hub on the drag side, place a 1¼-inch core in the center. Don't try to crowd too many patterns into a flask, provide a generous runner not less than 4 inches high, pour the metal slowly and fill the runner to the top. There is a chance that a certain amount of steam was present in the mold and it may be well to check up on your sand and see that it is not too wet nor rammed too hard.

Auto Parts Are Cast from Crucible Steel

(*Concluded from Page* 675)

only three full heats. Even at that much care is required in their preparation and handling. The new crucibles are annealed daily for ten days by placing them in the pits each night after pouring has ceased, and allowing them to cool gradually as the furnace itself cools. In some special work where higher temperatures are called for, the crucibles themselves are clay lined. Otherwise the standard graphite crucible for steel work is used.

The molding practice in most features corresponds with that for the production of any good steel castings. The Stony Creek plant has specialized on automobile and truck parts, and in some cases has produced castings which were seemingly impossible to make in steel. One casting was a differential case with a 1/8-inch wall. The secret of making this was to get a core of the right consistency. This core is large and had to be soft enough to give as the metal contracted, and yet tough enough to hold its shape and prevent erosion.

In describing the plant operation, Charles Reynolds, the manager, said that Stony Creek was selected for the plant merely because there was a suitable building available. However, deliveries are made by trucks, and Stony Creek is near many active industrial centers where the use of steel castings is heavy. At Meriden, Conn., a short distance to the north, several of the country's largest tableware manufacturers are located. These concerns use many ornamental dies made of crucible steel castings. Mr. Peterson, who handles the technical end of the business, has the advantage of twenty years spent in crucible steel work in Sweden.

The truck castings shown in Fig. 1 are made with exceptionally heavy risers. A few typical castings are shown in Fig. 2. Two chuck castings just as they are pulled out of the sand are shown in Fig. 3. Fig. 4 shows one of the furnaces in operation, and Fig. 5 shows the method of pouring. Note that the flasks are on edge.

Topics To Be Discussed

The sixth annual convention of the Ohio State Foundrymen's association which will be held at the Hotel Sinton, Cincinnati, Sept. 16 and 17, will have an interesting business program. Among the many interesting features offered are the following addresses:

"The Romance of Research" by Dean Herman Schneider, college of engineering, Cincinati University, Cincinnati; "Brass Foundry Problems" by Fred Wolf, Ohio Brass Co., Mansfield, O.; "Rational Cupola Melting" by E. J. Lowry, Hickman, William & Co., Chicago; "Foundry Costs" by A. E. Grover, Berea, O.; "The Foundryman's Interest in Railroads" by J. M. Fitzgerald, former president, Western-Maryland Railway Co.; "The Manufacture of Pig Iron" by George A. Richardson, Bethlehem Steel Co., Bethlehem, Pa.

Special entertainment and sightseeing tours are being arranged for the ladies of the party.

Holcroft & Co., Detroit, furnaces and oven builders, has opened branch offices in the Sloan building, Cleveland, and in the Putnam building, Chicago. The Cleveland branch will be in charge of H. M. Smith and the Chicago branch in charge of C. H. Martin.

Be Careful

When Operating Machine Tools In the Pattern Shop

By Walter C. Ewalt

NECESSITY, another word for competition, also is called the *Mother of Invention.* In all lines of endeavor, men strive to produce merchandise which is better and cheaper than any which has been made heretofore by themselves or their competitors. For this reason, power driven tools have been invented and perfected. The pattern shop has kept pace with the march of progress to a certain degree and while man's mind will conceive multiplicate shapes, forms and duties of castings, machine tools never will eliminate hand tools. Many machine tools are used either to give a special finish, or, as in a majority of cases, to rough out the work.

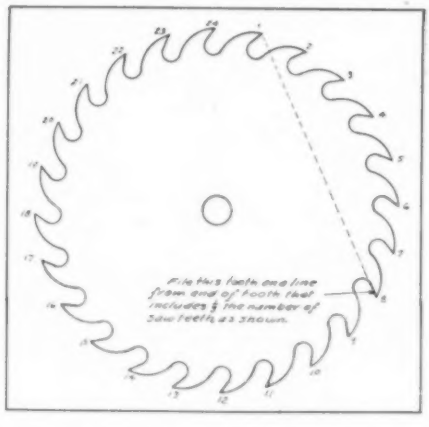
Ten machines which are found in a modern shop, are as important to the trade as the ten fingers are to the human body. They are the band saw, disk grinder, lathe, hand jointer, corebox machine, single surfacer, drill press boring machine, emery wheel or grindstone, circle saw and an automatic knife grinder. The above tools are the most important but may be supplemented by such tools as the wood milling machine, power router, bench band and circle saws, bench disk grinder, swing saw and scroll saw.

A potential danger exists in every machine run by power. In the woodworking machines particularly, the operations are extremely hazardous since the machines contain sharp cutting tools, are run at high speed and the materials are light.

It is deplorable that so many men, who have been hurt on these machines, have had long experience with them. That old saying, *familiarity breeds contempt* is often the common fault, for the workers forget the hidden danger. *More haste and less speed* should read in the pattern shop *more speed and less haste.* Barring tools which are defective and flaws which cannot be seen, few accidents will occur if one is careful. One need not be afraid to use them, but should maintain a *respectable* distance from those sharp edges.

It may be proper at this time to cite some of the safe practices suggested by the National Safety council, 208 S. LaSalle street, Chicago. The complete bulletin No. 20 may be obtained from that organization at a small cost. The various guards devised for saws, jointers and similar machines, necessary as they are, will not alone suffice to prevent accidents. Certain features of general arrangement, equipment and operations, as well as education and discipline are essential.

Eternal vigilance always is the price of safety. No one knows that better than the man who has charge of a shop. Sometimes it is the fastest men who seem the most careless.



STANDARD METHOD FOR FILING SAWS

Their minds are on their work and they want to get the job done quickly, consequently they neglect to use the guards, etc. Considerable is said about safety here because it is far better financially and otherwise, both for the workman and his employer, not to have an accident.

The proper arrangement of machines and drives is important. The use of individual motor drive is recommended, as it removes the hazard of overhead shafting and belts and improves illumination. The machines should be anchored securely to the floor to prevent excessive vibration. Sufficient space should be given between machines so that workmen can handle their work without interference. If a machine is located in or near an aisle-way, it should be fenced off while the workman is busy at that place. Proper illumination should be given each machine. Good illumination means efficiency, economy and increased safety.

Many machines are suitable for performing a variety of operations satisfactorily. However, it is difficult to provide an effective safeguard for the working point of a machine so used. In that case, additional care must be used by the operator if guards are removed and guards must be placed back on the machine as soon as he is through with his odd job. Starting and stopping devices should be within easy reach of the operator. Each machine should be stopped immediately after finishing an operation because it is dangerous to allow saws and other woodworking machine to run continuously.

An experienced person should have charge of keeping the machines and the cutting tools in proper condition. Frequent and thorough inspection is recommended. The floors should be kept in good condition and free from accumulation of waste material. The standing space at the machines should be covered with some antislip material to prevent the operator from slipping and possibly falling against the moving machinery. Rubber mats secured to the floor, heavy grade roofing paper, paint or glue applied to the floor and sprinkled with sand, worn disks from the sander are all used as antislip material. The floors should be kept clean and material piled properly. Workmen should wear tight fitting clothes. Smoking, as well as open lights, should be prohibited. Only safety matches should be carried in the pockets. Machines should be stopped when cleaning or wiping. All moving parts such as belts, clutches, pulleys, gears etc., should be enclosed by guards.

On the prevention of circular saw accidents, the following is recommended. It is important that every circular saw be equipped with a guard of a type most suitable for the work and then to see that the guard is

used on all work where practicable. Ripsaws should be provided with a spreader or splitter which prevents the wood from binding on the saw blade. The operator of ripsaws should never stand directly in front of the saw as he might be struck by the board if it should kick back.

It is important that circular saws be sharpened properly, to be safe and efficient. A common rule is to sharpen on a line drawn from points at one-third of the circumference as shown in the accompanying illustration. Many accidents have resulted from the dangerous practice of workmen attempting to use a ripsaw for cutoff work or a cutoff saw for ripping.

Safe rim speed for circular saws is 9425 feet per minute. Always use a push stick when ripping narrow pieces or removing blocks from behind cutoff saws. KEEP THE HANDS IN THE CLEAR.

Safe speeds corresponding to a rim speed of 9425 feet per minute:

Diam. of Saw	R. P. M.
12 inches	3000
14 inches	2570
16 inches	2245
18 inches	2000
20 inches	1800

Bandsaw wheels and the up-running side of the saw blade should be guarded completely. The working side of the blade should be guarded above the guide roll or gage. The guard may be attached to the gage so that it will move up and down with the gage.

Care should be taken in sharpening and brazing the saw blades. Bandsaws are operated at speeds of from 3500 to 8000 feet per minute, the heavier saws running at the higher speeds. The speed may be obtained by multiplying the circumference—in feet—of the pulley by the revolutions per minute.

Hand fed jointers and planers should be equipped with safety cylinder heads and in addition, every planer should be equipped with a guard. Bench planers are recommended for planing short pieces. If a short piece is planed on the large planer, use the push blocks.

Disk sanders should be enclosed entirely beneath the table.

The writer recommends placing the National Safety council's bulletin No. 20 in the hands of all men who work on woodworking machinery and especially to those just starting to work in a woodworking shop.

Determining Air Pressures in Cupolas

By R. R. McGowan

AIR is introduced into the cupola to bring a certain amount of oxygen into contact with the carbon in the coke and produce heat giving gases, namely carbon dioxide (CO_2), or carbon monoxide (CO). Carbon dioxide is formed when complete combustion takes place. This gas results from combustion when an ample supply of air passes into the cupola at a comparatively low temperature. It has been determined that 11.6 pounds of air is required to combine with 1 pound of carbon to form carbon dioxide gas. The theoretical amount of air at normal temperature and pressure necessary to burn one pound of coke containing 90 per cent carbon to carbon dioxide is 136.66 cubic feet. This is shown by the fact that 1 cubic foot of air at normal temperature and pressure equals 0.0764 pounds and 1 pound of air at normal temperature and pressure equals 13.09 cubic feet. Then

$$\frac{1}{0.0764} = 13.09, \text{ and}$$

$$\frac{13.09 \times 11.6 \times 9}{10} = 136.66 \text{ cubic feet.}$$

For each pound of coke charged into the cupola it is necessary to introduce approximately 136.66 cubic feet of air. Approximately 13.666 cubic feet of air is required per pound of iron melted, or 30,612 cubic feet of air is required for each ton of iron melted. Theoretically it is wrong to measure air passing into the cupola by the volume, since air expands 1/273 part of its volume for each degree rise in temperature above 0 degree Cent. For present calculations the normal temperature of air is considered as 15.5 degrees Cent. and the normal pressure 29.9 inches. Assuming the air contains a normal amount of moisture, the figure for the weight of a cubic foot of air at normal temperature and pressure, namely 0.0764 pounds, is not sufficiently accurate to meet the demands of the scientist, but may be used as a working figure for foundrymen dealing with air entering the cupola. The following values may be used: One cubic foot of air at normal temperature and pressure equals 0.0764 pound and one pound of air at normal temperature and pressure equals 13.09 cubic feet. For comparison, it may be noted that 1 cubic foot of air at 0 degree Cent. equals 0.087 pound and 1 pound of air at 0 degrees Cent. equals 12.39 cubic feet.

Since approximately 13.666 cubic feet or 1.044 pounds of air is required to produce sufficient heat from coke containing 90 per cent carbon to melt one pound of iron in the cupola, the formula for determining

TABLE I

Pounds of Air at Normal Temperature and Pressure

Diameter of cupola inches	Average melting capacity pounds per hour	Volume or air required at normal temperature and pressure cubic feet per minute	Weight of air required pounds per minute
24	4524	1030	78.69
30	7069	1610	123.00
36	10179	2318	177.10
42	13854	3155	241.04
48	18096	4121	314.84
54	22902	5216	398.50
60	28274	6440	492.02

TABLE II

Pounds of Air Required for Cupolas

(Porter's Formula)

Diameter of cupola feet	Area of cupola square feet	Air required per minute From	To
2.0	3.1416	78.54 pounds	94.25 pounds
2.5	4.9087	122.72 pounds	147.26 pounds
3.0	7.0686	176.72 pounds	212.06 pounds
3.5	9.6211	240.53 pounds	288.63 pounds
4.0	12.566	314.15 pounds	376.98 pounds
4.5	15.904	397.60 pounds	477.12 pounds
5.0	19.635	490.88 pounds	589.05 pounds

TABLE III

Conversion Table of Cubic Feet of Air at Normal Temperature

Pounds to cubic feet			Pounds to cubic feet			Cubic feet to pounds			Cubic feet to pounds		
1	equals	13.09	60	equals	785.4	1	equals	0.0764	60	equals	4.584
2	equals	26.18	70	equals	916.3	2	equals	0.1528	70	equals	5.348
3	equals	39.27	80	equals	1047.2	3	equals	0.2292	80	equals	6.112
4	equals	52.36	90	equals	1178.1	4	equals	0.3056	90	equals	6.876
5	equals	65.45	100	equals	1309	5	equals	0.3820	100	equals	7.65
6	equals	78.54	200	equals	2618	6	equals	0.4584	200	equals	15.28
7	equals	91.63	300	equals	3927	7	equals	0.5348	300	equals	22.92
8	equals	104.72	400	equals	5236	8	equals	0.6112	400	equals	30.56
9	equals	117.81	500	equals	6545	9	equals	0.6876	500	equals	38.20
10	equals	130.90	600	equals	7854	10	equals	0.7640	600	equals	45.84
20	equals	261.8	700	equals	9163	20	equals	1.528	700	equals	53.48
30	equals	392.7	800	equals	10472	30	equals	2.292	800	equals	61.12
40	equals	523.6	900	equals	11781	40	equals	3.056	900	equals	68.76
50	equals	654.5	1000	equals	13090	50	equals	3.820	1000	equals	76.40

the number of cubic feet of air per minute required for any cupola is as follows:

Average melting capacity of cupola in pounds per hour $\times \frac{13.66}{60}$ = Air required in cubic feet.

The application of this formula is as follows: Find the quantity of air at normal temperature and pressure in cubic feet per minute required for a cupola 24 inches in diameter with an average melting capacity of 4524 pounds per hour. Using the formula,

$$\frac{4524 \times 13.666}{60} = 1030.4164 \text{ cubic feet}$$

per minute.

Table I has been constructed from this formula and gives the amount of air at normal temperature and pressure required per minute for cupolas from 24 to 60 inches in diameter. The values given for the average melting capacity in the table were calculated by the following formula:

Average melting capacity in pounds per hour = area of melting zone in square inches x 10.

The number of pounds of air at normal temperature and pressure may be determined for cupolas of any diameter as follows:

Cubic feet of air at normal temperature and pressure per minute x 0.0764 = pounds of air required per minute

This formula may be applied as follows: A cupola 24 inches in diameter of average melting capacity, for example 4524 pounds per hour, requires 1030 cubic feet of air per minute at normal temperature and pressure. To find the weight of air in pounds per minute passing into the cupola, formula No. 2 is used.

1030 x 0.0764 = 78.69 pounds of air

The values for the weight of air required, as shown in Table I, were calculated from this formula.

John J. Porter, late professor of the University of Cincinnati, and an authority on the cupola, states that the maximum output is obtained with 25 to 30 pounds of air per minute for each square foot of area in the melting zone. For the purpose of comparison his figures are given in Table II.

When converting cubic feet of air at normal temperature and pressure into pounds, Formula No. 3 is used as follows:

Cubic feet of air at normal temperature and pressure x 0.0764 = pounds of air.

This formula may be used as follows: Converting the quantity of air required for the cupola, namely 1030 cubic feet, into pounds of air,

1030 x 0.0764 = 78.69 pounds of air.

Pounds of air is converted into cubic feet of air at normal temperature and pressure by using the following formula:

$$\frac{\text{Pounds of air}}{0.0764} = \text{Cubic feet of air at normal temperature and pressure.}$$

This formula may be used as follows: If the amount of air required for a cupola is 78.69 pounds, how many cubic feet of air at normal temperature and pressure does this represent?

$$\frac{78.69}{0.0764} = 1030 \text{ cubic feet of air at normal pressure and temperature.}$$

Table III will be found useful for the conversion of cubic feet of air to pounds, or from pounds to cubic feet of air. The air is taken at normal temperature and pressure. Several examples may serve to illustrate the use of this table.

Find the value in pounds of 987 cubic feet of air at normal temperature and pressure from Table III.

Cubic feet		Pounds
900	=	68.76
80	=	6.112
7	=	0.5348
Total 987	=	75.4068

Find the value of 789 pounds of air at normal temperature and pressure from Table III.

Pounds		Cubic feet
700	=	9163.00
80	=	1047.20
9	=	117.81
Total 789	=	10328.01

Chilled Rings Crack

Question: Approximately 50 per cent of our large chilled rings cracked after they have been cast and we shall appreciate any information you can give us that will enable us to remedy this condition. The ring is 4 feet 8 inches diameter on the inside, 3 inches thick, 10 inch face and is plain both inside and out with the exception of six slotted lugs on the inside designed to hold it in place. The outside face is chilled to a depth of ¾ or 1 inch.

Answer: The information you supply is too vague on which to base a definite opinion. The trouble may be due to your iron mixture, the method in which it is melted and poured. It may be due to the design and thickness of the ring employed for a chill. It may be due to the manner in which the casting is treated after it is cast. Again, you do not state for what purpose the ring is intended and therefore we are led to wonder why you do not use a hard iron mixture similar to that used in tires on the wheels set up in grinding pans, instead of attempting to chill the outside face. In the event that you may be interested, the following mixture is used by a prominent manufacturer of clay machinery for tires that correspond closely in shape and size to the casting you are making: 80 per cent white pig iron and 20 per cent return hard gates and risers. These castings are hard all the way through and therefore do not need to be chilled.

Your method of molding may be responsible for the cracking of the castings. A normal iron casting 5 feet diameter will contract approximately ⅝-inch in diameter. A chilled casting will contract a little more.

Milestones in Foundry Progress

As Recorded in the September Issues of THE FOUNDRY, Thirty, Twenty and Ten Years Ago

1896

GROVER CLEVELAND

A LOW fuel ratio does not in itself imply that it results in economy. Some foundries have a serious discount to face on account of dull iron and would be practicing a better grade of economy by using enough more fuel to avoid this manufacture of scrap. And some of these very same shops are the ones that attempt to set the world's record for a melting ratio! Gentlemen, this is not melting iron. It is just thawing it out, and the weight attached to a low fuel ratio in such cases ought not to be heavy.

KRANK'S KORNER

* * *

Undue skimping of coke doesn't pay any better than applying green goggles to the mule and feeding him with shavings.

* * *

The first meeting of the newly organized Pittsburgh Foundrymen's association was held July 31, 1896, and the second early in September of that year. Robert Taylor, Taylor, Wilson & Co. was president; J. D. Seaman, Seaman & Sleeth, treasurer and F. H. Zimmers, Union Foundry & Machine Co., secretary.

* * *

The bell for the city hall tower in Milwaukee was cast in August at the foundry of Gardiner, Campbell & Sons in that city.

* * *

James Chalmers, the tramp molder, was entranced with the city of Detroit, where his wandering feet carried him in search of a job. He hit "Young Jack" Smith, foreman of the Riverside Iron Works, a marine shop, for a place. Smith walked around the shop making small balls of clay with his fingers and shooting them with an unerring flip at the men who were not busy.

* * *

Not a bad way to remind one that the boss' eye is on him.

* * *

The foundry of the Otis Brothers & Co., now the Otis Elevator Co., Yonkers, N. Y. suffered a disastrous fire in the year 1896.

The York Mfg. Co., York, Pa. closed a contract for 100 tons of machinery castings for its new electric crane equipped shop

* * *

The Grey Iron Castings Co., Mt. Joy, Pa. just had moved into its new shop, having vacated its older plant in favor of railroad track extensions. The company then, as now, made hardware and iron toy specialties.

Faked Foundry Facts

A Green Core

1906

THEODORE ROOSEVELT

A COMPLETE account of the third annual convention of the British Foundrymen's association as reported in THE FOUNDRY for September, 1906, contains many names which *since* have become familiar to American foundrymen. Among these are F. J. Cook, J. Shaw, P. Longmuir, and Prof. Thomas Turner. Herbert Pilkington was president.

* * *

George W. Kelly, Columbus, Ga. described a dry sand mold which had produced 14 duplicate castings and from its condition seemed to promise four to six more before its destruction. The castings were cylinders 32 inches outside diameter and 7 feet, 7 inches long, with the bottom end closed and the top open, with wing flanges cast on the outer surface. The castings were poured on end, new cores being used for each castings, but the mold served again after receiving a coat of blacking.

* * *

Arthur Simonson described the equipment necessary for a steel foundry laboratory.

* * *

No. 2 foundry iron was selling from $18.50 to $20 a ton and southern and northern furnaces alike were practically sold out.

* * *

Benjamin D. Fuller who had been in charge of the Allegheny foundry of the Westinghouse Electric & Mfg. Co. was made general superintendent over that foundry and the one at Cleveland.

1916

WOODROW WILSON

STAGE all set for the Cleveland convention of the American Foundrymen's association, according to the September issue of THE FOUNDRY in 1916. The first Cleveland convention, in 1906, found the association with a membership of 300. This was advanced to more than 1000 in 1916 and today it approaches closely to 2000.

F. B. Whitlock, then connected with the Interstate Foundry Co., Cleveland, was chairman of the local committee with Phillip Frankel as vice chairman and Mrs. W. C. Sly chairman of the ladies reception committee.

* * *

Statistics on the foundry plants of the country showed a total of 6507 shops.

* * *

Joseph Harrington offered the first of series of articles on powdered coal as a fuel in the malleable foundry.

* * *

No. 2 foundry iron was bringing $19.45 Pittsburgh and $13.50 Birmingham.

The Shakeout

DAN M. AVEY, Editor

PAT DWYER, Engineering Editor
FRANK G. STEINEBACH, Associate Editor

CHARLES VICKERS, Nonferrous Editor
EDWIN BREMER, Associate Editor

¶ Why Do Golfers Golf?

BRUSHING aside for the moment all the alleged reasons and in like manner ignoring many of the contributory and well known reasons social, political, religious or industrial, why men join golf clubs, any earnest seeker is bound to stumble upon the truth if he pursue his investigation far enough. It is based upon a primitive instinct that goes back to the time when a man's dinner and perhaps his life depended on the accuracy and skill of his eye and arm. If he sliced in the rough he lost his dinner and it is a safe bet that if he failed to hole in one his intended victim quite thoroughly saw to it that he was given no second chance. This repressed instinct is in every man. It finds a natural outlet in the activity of men who work with their hands. Others take up golf. Before condemning this theory take a look around the circle of your friends and acquaintances and count the number of manual laborers who play golf.

EXAMPLES of castings made by apprentices in many foundries will constitute one of the interesting features at the coming convention in Detroit. They will represent the degree of skill and knowledge acquired by the boys who made them and perhaps incidentally reflect the capacity of their teachers to impart instruction. A committee of experienced foundrymen has been appointed to pass upon these castings and suitable prizes will be presented to the boys whose work shows the greatest degree of merit. Many boys, like many men have a natural craving to work with their hands and these are the boys who make expert mechanics. A combination of mental ability and manual skill will carry a boy from the floor, or bench, to the office. The old primitive urge to handle the tools remains, but in some instances the accompanying grime prevents him and—he takes up golf instead. He hobnobs with the boys who never handled tools in their young days and now are trying to satisfy the age old urge by correlating the effort of eye and hand.

Methods of producing castings slowly are changing, but the fundamental principles probably always will remain the same. An all around knowledge of foundry operation is not essential to a man who does not aspire to an executive position. For the same reason a man may develop into a successful manager without any great amount of preliminary manual training. However, knowledge and manual skill are no burden to carry and the manager who has them regards them as the peak feathers in his cap.

¶ Times Demand New Products

NEW developments in engineering continually keep the wideawake foundryman burning the midnight oil to figure out ways and means whereby he can make a casting strong enough to stand the *gaff*. In the field of power generation where many castings are used, the mercury turbine operating under high temperature has been developed and found to be extremely efficient. Steam pressure in central power stations is increasing to 700 pounds and still going up. One unit of the new Edison power plant at Weymouth, Mass., will deliver steam at 1200 pounds, and at Rugby, England, boilers are supplying steam at 3200 pounds.

An interested reader cogitating on this upward trend of steam generation says:

"I wonder if the foundryman, ferrous or nonferrous, can see any handwriting on the wall. Imagine 3200 pounds steam pressure on a casting! What is going to be the effect of this pressure and temperature?"

HE is not the only one who desires an answer to that question. Much research and investigation now is being carried on by firms manufacturing castings for high steam pressures. Valuable information has resulted with more yet to come because painstaking investigation will solve the problem.

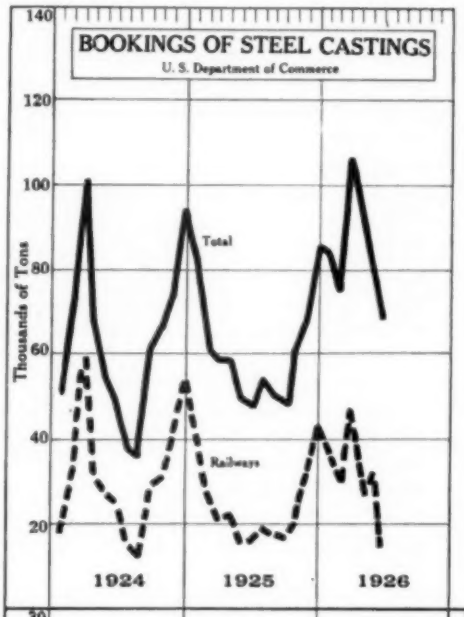
The foundryman who follows the developments in the mechanical field and keeps his foundry abreast with them will be able to furnish castings that will fill the bill. And *he* will not face universal competition at least for some time.

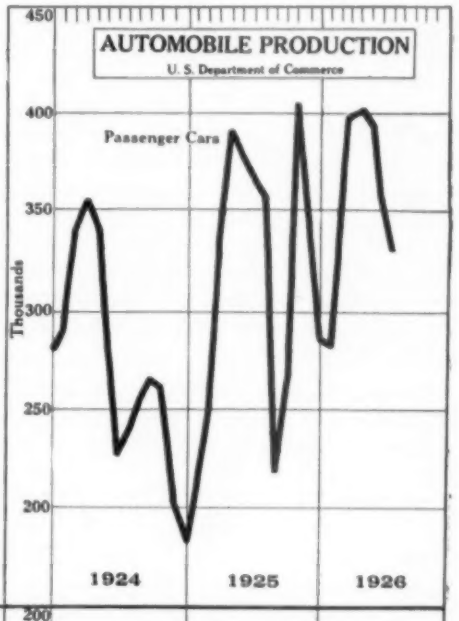
Trade Trends in Tabloid

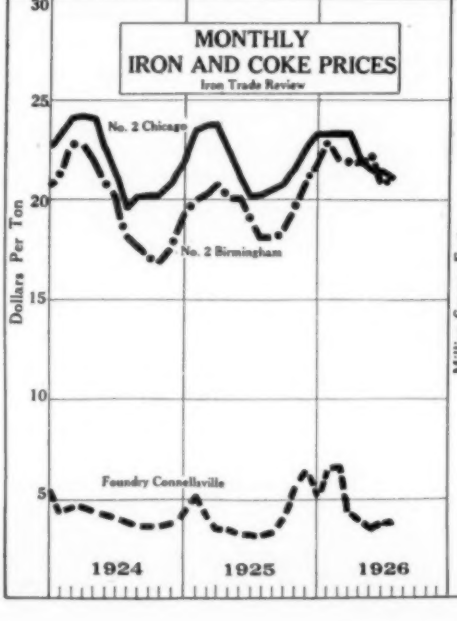
WHILE a midsummer slump has failed to put in its appearance in many industries the castings manufacturing establishments report a slight decline in operations during the latter part of July and extending into August. Automobile production has dropped slightly, but still is well above the summer period of last year and 1924. A number of the large cylinder jobbing shops continue to operate at capacity and the activity of the different automobile plants is varied in line with the demand of the public for the different makes of machines. Railroad operations continue at a peak, with a slight decline in the surplus of freight cars in good repair. However, car building is slow and foundries making railroad castings are experiencing a dullness, unlightened by the prospect of early orders. The Ohio State Foundrymen's association reports July operations at 76.8 per cent of normal compared with 80.3 per cent for June and 85.3 per cent for July, 1925. Stocks on hand have declined to 79 per cent and stocks received dropped to 56 per cent during July. Nonferrous foundry operations have increased, standing at 72.4 per cent in July, compared with 68.6 per cent in June. Building construction is going ahead satisfactorily throughout the country. Plumbing goods shops and sanitary ware foundries are busy. Continued demand for cast iron pipe is maintaining operations.

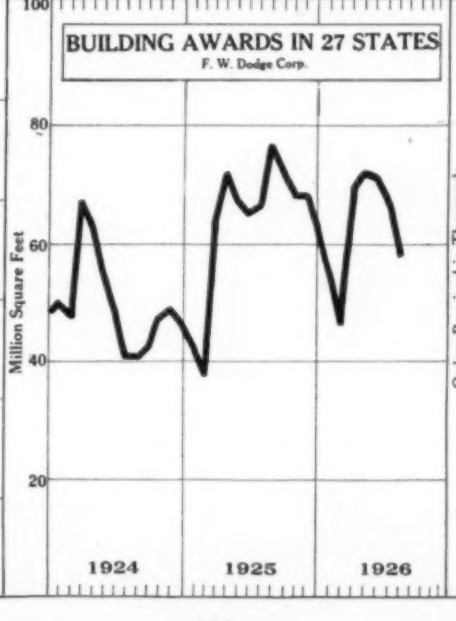
RAW MATERIAL PRICES
Aug. 24, 1926

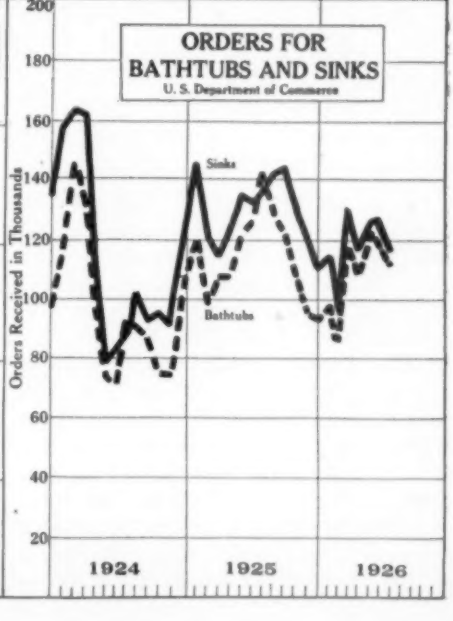
Iron	
No. 2 foundry, Valley	$17.50 to 18.50
No. 2 Southern Birmingham	21.00
No. 2 foundry, Chicago	21.00
No. 2 foundry, Philadelphia	21.26 to 21.76
No. 2 foundry, Buffalo	20.00
Basic, Valley	17.50 to 18.00
Basic, Buffalo	19.00
Malleable, Chicago	21.00
Malleable, Buffalo	20.00
Coke	
Connellsville foundry, coke	$4.00 to 4.50
Wise County foundry coke	4.50 to 5.00
Scrap	
Heavy melting steel, Valley	$17.00 to 17.50
Heavy melting steel, Pitts	17.50 to 18.00
Heavy melting steel, Chicago	14.00 to 14.50
Stove plate, Chicago	14.75 to 15.00
No. 1 cast, New York	12.75 to 14.00
No. 1 cast, Chicago	17.00 to 17.50
No. 1 cast, Philadelphia	18.00 to 18.50
No. 1 cast, Pittsburgh	17.50 to 18.00
No. 1 cast, Birmingham	16.50 to 17.00
No. 1 cast, Buffalo	16.00 to 16.50
Car wheels, iron, Pittsburgh	17.00 to 17.50
Car wheels, iron, Chicago	16.50 to 17.00
Railroad malleable, Chicago	17.50 to 18.00
Agricultural, mall., Chicago	15.25 to 15.75
Malleable, Buffalo	17.00 to 17.50
Railroad Malleable, Pitts	18.50 to 19.00
Nonferrous Metals	Cents per pound
Casting copper, refinery	13.95
Electro copper, refinery	14.25 to 14.35
Straits tin	65.25
Lead, New York	8.90
Antimony, New York	16.00
Nickel, electro	39.60
Aluminum, No. 12, prod'rs	27.00
Aluminum, No. 12, remelt	22.50 to 23.00
Zinc, E. St. Louis, Ill	7.45 to 7.50











Personal

F. A. Whitten has been made engineer in charge of designs and developments for the American Car & Foundry Co. at Detroit.

L. F. Belnap, newly elected president of the Worthington Pump & Machinery Corp., New York, soon will remove from Montreal to New York headquarters.

F. R. Benson is to retire from the Terre Haute Malleable Mfg. Co., Terre Haute, Ind. He is disposing of his interest to a group of Milwaukee men headed by L. M. Eyke. H. L. Arnold remains as treasurer. Mr. Eyke has been with the company since 1907 and built the first foundry. James Garrard of Milwaukee will join the company and will have charge of the production.

T. I. Driggs, a vice president of the Scovill Mfg. Co., Waterbury, Conn., and president of the American Pin Co., a subsidiary, has resigned from both connnections due to ill health. He had been with the American Pin Co., since 1907 and was elected president and treasurer in 1919 succeeding his father, G. A. Driggs. When the American Pin Co. was taken over by the Scovill company in 1923 he was elected vice president of the latter company and made general manager of the subsidiary.

George Stanton, formerly with S. Cheney & Son, Manlius, N. Y., has resigned to accept a position as production manager for the Crouse & Pope Foundry Corp., Auburn, N. Y. Mr. Stanton at various periods has been foreman for the Buffalo Pitts Co., Buffalo; the Standard Foundry Co., Buffalo, and the Cyrus Currier & Sons, Newark, N. J. For the past 10 years he had been connected with S. Cheney & Son, being general foreman of plant No. 1 for five years and superintendent of all plants for five years.

Camille Didier who for several years has been general secretary of the Association Technique de Fonderie de France has tendered his resignation owing to the fact that the greater part of his time is taken up by his position as editor of the Usine and the Fonderie Moderne. The new general secretary of the French association now is Achille Brizon. M. Brizon, who took his engineering degree at the Ecole Centrale des Arts et Manufactures in 1913, has been foundry manager at the automobile works of De Dion Bouton. He now is managing director of the Société Anonyme Fonderie Brizon which he founded. M. Brizon has contributed several papers devoted to research in foundry practice and has co-operated in some investigations conducted by Albert Portevin.

Changes Connection

Al. V. Magnuson, formerly with the Davenport Foundry & Machine Co., Davenport, Iowa, now is affiliated with the Wm. H. Nicholls Co. Inc., Brooklyn, N. Y. Mr. Magnuson was associated with the Henry E. Pridmore Inc., Chicago, for about 18 years. During the latter years of his association he acted as shop superintendent and designed and built the heavy type, power, trunnion, rollover machine and the electric jolt and rollover molding machines. About 8 years ago he left the Pridmore company and became connected with the Davenport Foundry & Machine Co., where he developed another line of molding machines. In his new connection with the Wm. H. Nicholls Co., he will work on development and design of rollover machines and also represent the firm in the Chicago territory.

Receives Appointment

Prof. W. L. DeBauffre, chairman, mechanical engineering department, University of Nebraska, Lincoln, Nebr., has been added to the research staff of the International Combustion Engineering Corp., New York. Professor DeBauffre will continue his consulting work for the United States bureau of mines. He is a member of the board of helium engineers and of the advisory committee on the use of oxygen or oxygenated air in metallurgical and allied processes.

Firm Lets Contract

The Shenango Furnace Co. Sharpesville, Pa., has let a contract to the McClintic-Marshall Co., Pittsburgh, for the erection of a modern and fully equipped foundry for the manufacture of ingot molds and other castings. The plant will be erected on the property of the Shenango company at Sharpesville and directly connected with its two 600-ton blast furnaces, thus minimizing transportation of the molten metal and securing all of the savings available through concentration of facilities. Erection of the structures will be rushed with the expectation that operations may be begun early in 1927.

Obituary

William B. Reed, vice president and general sales manager, H. B. Smith Co., Westfield, Mass., operator of large foundries in that city, died Aug. 5 at Edgartown, Martha's Vineyard, Mass. He was 57 years old and a past president of the National Boiler and Radiator association. He also had been connected actively with many civic affairs.

John E. Thropp, president, John E. Thropp's Sons Co., Trenton, N. J., died Aug. 12 at his home at Penn Manor, near Trenton. Mr. Thropp had been in ill health for the past five years. He was 61 years of age. As president of his company, he built up a large business in the manfacture of tire machines. He also was president of the DeLaski-Thropp Co., Trenton, designers of tire making machines and holders of patents on rubber equipment.

Eldridge W. Hotchkiss, for many years a prominent figure in malleable castings production, died Aug. 16 at his home in Cleveland Heights, Cleveland, aged 82 years. Mr. Hotchkiss had not been active in industry since 1904. He was superintendent and a director of the Cleveland Malleable Iron Co., Cleveland, at the time it became a part of the National Malleable & Steel Castings Co. He had been a director also of the Eberhard Mfg. Co. He was the father of Charles W. Hotchkiss, present manager of production at the Cleveland plant of the National Malleable company. The late Mr. Hotchkiss started to work for the Cleveland Malleable company in 1869.

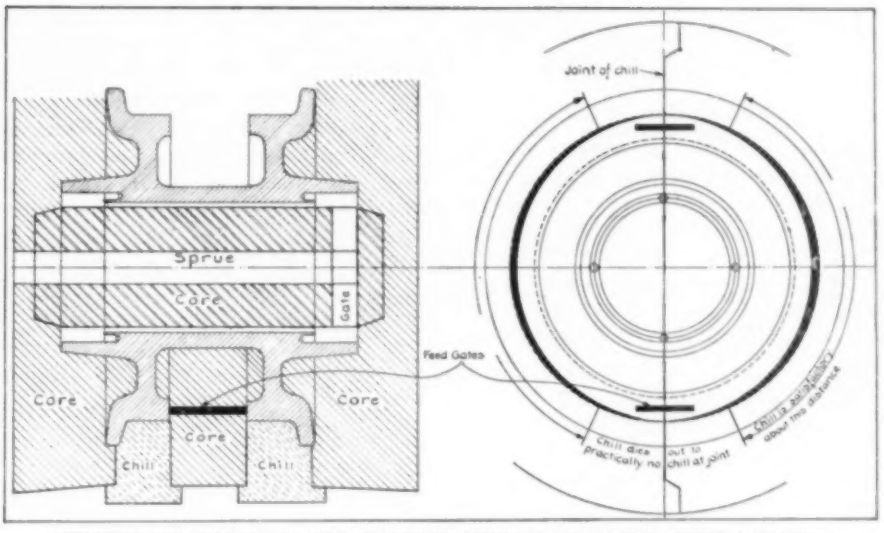
Austin Official Killed

Claude F. Chard, Cleveland district sales manager for the Austin Co., Cleveland, engineer and builder of industrials plants was killed Aug. 14 when his automobile overturned near Crestline, O. He was returning to Cleveland from Columbus, O., where he had been on business. Mr. Chard was born in New Jersey and was graduated in engineering from Purdue university, Lafayette, Ind. He had been with the Austin Co. for more than ten years, being at one time in charge of its Philadelphia office.

Eagle Oil & Supply Co., Boston, has been appointed distributor for Quigley Furnace Specialties Co. Inc., New York. The Eagle company will cover eastern Massachusetts and Rhode Island.

Style of Gate Affects Chill on Tread

Question: We have had considerable trouble with the small truck wheel shown on the accompanying blueprint. You will note that we have added several lines illustrating the method of molding the casting and also have indicated the area unaffected by the chill. We stack the cores and chills and employ a weight to hold the mold together. We get a nice casting and a satisfactory chill except in front of the chill joint. A bail and clamp prevent the half chills from spreading. Thinking that the chills possibly might spread at the joint we have placed a solid ring around the split chill, but the result in both cases was the same. The chills are machined all over and present a tight joint. Recently we have added the feed gates shown connecting the upper and lower rim. These produce a slight chill at the joint where previously we had none. We cannot understand why a joint in the chill face should affect its chilling quality and will appreciate any advice you may give us on the subject.



METHOD OF MOLDING AND PLACING CHILLS ON LIGHT TRUCK WHEEL

Answer: The trouble is not with your chill, but with the manner in which your mold is gated. Intead of pouring the metal through two little gates at the bottom, power it through six pop gates pierced through your cover core and in a ring around the center core. A small ring core placed over the center will serve for a pouring basin. You do not give the analysis of the iron but we assume that it is on the border between an iron that will chill and one that will not chill.

You are familiar of course with the fact that hot iron will chill deeper under similar circumstances than iron that is comparatively cool. In addition iron that is poured cold will present a smoother skin than iron poured hot. Taking all the foregoing factors into consideration furnishes a basis for the following theory accounting for the erratic manner in which the wheel treads were chilled in your plant.

The iron was compartively cool entering the mold through two small gates at the bottom of the hub. It came in contract with the lower chill at two points opposite the two gates and a great deal of the heat was absorbed on its journey around the ring. At the point where the two streams met it was not hot enough to chill. The same holds true for the upper ring only in a greater degree. You state that the non-chilled portion of the rim was on the area immediately on both sides of the joint in the the chill. This may have been the case in the event that the gates in the bottom of the hub core pointed 90 degrees away from the joints in the chill. However, we venture the assertion that if the gates pointed in any other direction, the non-chilled area would not be found opposite the gate entrances. By pouring the metal through six evenly spaced pop gates on the top you will get an even distribution of hot metal and the effect of the chill will be imparted uniformly to the wheel tread.

Foundry Association Directory

The Buffalo Foundrymen
Buffalo

President, J. McARTHUR, Washington Iron Works; secretary, W. J. WARK, E. J. Woodison Co., 146 Chandler street. Meetings the third Wednesday of the month at 146 Chandler street.

Chicago Foundrymen's Club
Chicago

President, CHARLES L. LARSEN, Armour Institute of Technology, 3200 Federal street, Chicago; secretary-treasurer, E. C. BARRINGER, THE FOUNDRY, 1147 Peoples Gas building, Chicago. Meetings second Saturday in each month at the City club, 315 Plymouth court.

Detroit Foundrymen's Association
Detroit

President, ROBERT G. CRAWFORD, Atlas Foundry Co., 131 South Artillery street, Detroit; secretary, RUSSELL M. SCOTT, Packard Motor Co., 1580 East Grand boulevard, Detroit. Meetings third Thursday in each month at the Union League club, 35 Grand River avenue, Detroit.

Metropolitan Brass Foundry Association
New York

President, THOMAS HARPER, Thomas Harper, 204 Lafayette street, New York; secretary, WM E. PAULSON, Thomas Paulson & Son Inc., 97 Second avenue, Brooklyn, N. Y. Meetings second Wednesday in each month at the Building Trades club, 34 West Thirty-third street, New York.

Newark Foundrymen's Association
Newark, N. J.

President, J. L. CARTER, Barlow Foundry, Inc., Newark; secretary, W. H. MANTZ, Atlas Foundry Co., Irvington, N. J. Meetings called by president.

New England Foundrymen's Association

President, H. P. BLUMENAUER, Arcade Malleable Iron Co., Worcester, Mass.; Secretary, FRED F. STOCKWELL, 205 Broadway, Cambridgeport, Mass. Meetings second Wednesday of each month at the Exchange club, Boston. Outings usually are held in the summer months.

Ohio State Foundrymen's Association

President, WALTER L. SEELBACH, Walworth Run Foundry Co., 2488 West Twenty-seventh street, Cleveland; secretary-manager, ARTHUR J. TUSCANY, 5713 Euclid avenu, Cleveland. Convention Hotel Sinton, Cincinnati, Sept. 16 and 17.

Philadelphia Foundrymen's Association
Philadelphia

President, WALTER WOOD, R. D. Wood & Co., Philadelphia; secretary, HOWARD EVANS, J. W. Paxson Co., Luzerne and D streets, Philadelphia. Meetings the second Wednesday of each month at the Manufacturers' club.

Pittsburgh Foundrymen's Association
Pittsburgh

President, WILLIAM K. FRANK, Damascus Bronze Co., South avenue, N. S. Pittsburgh; secretary-treasurer, WM. J. BRANDT, Wm. J. Brandt, Bessemer building, Pittsburgh. Meetings on the third Monday of the month, except in July and August, at Fort Pitt hotel.

Quad-City Foundrymen's Association
Davenport, Iowa

President J. H. DIEDRICH, Blackhawk Foundry & Machine Co., Davenport, Iowa; secretary-treasurer, A. D. ZIEBARTH, Davenport Foundry & Machine Co., Davenport, Iowa. Meetings the third Monday evening of each month, the meeting place being rotated between Moline, Rock Island and Davenport.

Southern Metal Trades Association
Atlanta, Ga.

President, GEORGE B. COCKER, Gastonia, N. C.; secretary-treasurer, W. E. DUNN JR., Healey building, Atlanta, Ga.

Tri-City Technical Council
Moline, Ill.

Chairman, H. BORNSTEIN, Deere & Co., Moline, Ill.; treasurer, MAX SKLOVSKY, Deere & Co., Moline, Ill. Combined meetings held only one or two times a year on call.

Tri-State Foundrymen's Association
Cincinnati

President, HAROLD P. RITTER, John A. Oberhelman Foundry Co., 3323 Colerain avenue; secretary, GEORGE W. PIEHL, Wessling Bros. Foundry Co., 1607 McLean avenue. Meetings the second Thursday of each month at the Cincinnati club, Eighth and Race streets.

Twin City Foundrymen's Association
Minneapolis-St. Paul

President, J. A. TEACH, Minneapolis Steel & Machinery Co., Minneapolis; secretary-treasurer, C. E. LANGDON, 3849 Lyndale avenue, So., Minneapolis. Meetings monthly at the Athletic club.

Mold for Fly Wheel Made in Dried Cores

By William Pink

Several rather unusual features marked the production of the largest and heaviest steel casting made to date in a Manitoba, Canada, foundry. The casting, a flywheel 7 feet in diameter and weighing 14,000 pounds was cast recently in a dry sand mold made up entirely of cores in sections.

The cores were made and dried in the coreroom of the iron foundry and then shipped 25 miles by truck to the open hearth department of a steel rolling mill plant where a 10-ton furnace melted the steel for the ingots. Auxiliary equipment and a flask large enough to enclose the mold also were sent with the cores.

Floor sand was rammed to a predetermined height in the flask and then scraped off level and flush with the upper face of the bottom hub core No. 1. Eight sections of the core No. 2 were assembled on this bed to form the bottom face of the mold. The corresponding core on the upper side. No. 3 was assembled in 12 sections, six plain and six with riser openings over the rim of the wheel. A suitable check on the outer end of the lower cores formed a guide for setting the rim cores No. 4. A similar check on the outer end of the upper cores guided them into place.

Core No. 5 formed a cover for the hub. It was provided with runner and riser openings, also an opening in the center for the reception of the hub chamber core. The cover core fitted snugly over a shoulder in the top of the center core and thus anchored it in place. Spool chaplets in the web of the wheel supported the upper cores, No. 3.

A cast iron plate was used to cover the core assembly and was provided with the necessary openings for the risers and runner. Block cores were employed to build the risers and runner to the required height. No. 4 cores were blocked against the inside of the flask and the space between was rammed full of sand. Binder bars top and bottom held in place with long bolts held the assembled mold securely.

Companies Consolidate

On Aug 1 the J. W. Paxson Co., and the M. R. Taggart Co., both of Philadelphia, consolidated their foundry sand, facing and supply businesses under the name of Paxson-Taggart Inc., with offices at Luzerne and D streets, Philadelphia. The management of the new firm will be in the same hands as was the management of the individual companies. The officers and directors will be Albert Walton, president; Merril R. Taggart, vice president and general manager; Franklin B. Platt, secretary and Gilbert P. Albrecht, treasurer. Mr. Taggart began with the Paxson company as a boy in 1910. Later he became connected with the T. P. Kelly & Co. Inc., New York, for a few years and then returned to the Paxson company. About seven years ago he started in business for himself in the sand and supply business with Gilbert P. Albrecht.

Foundry equipment will continue to be made and sold by the J. W. Paxson Co., at Luzerne and D streets. The new firm will take care of the foundry sand, facings and supplies.

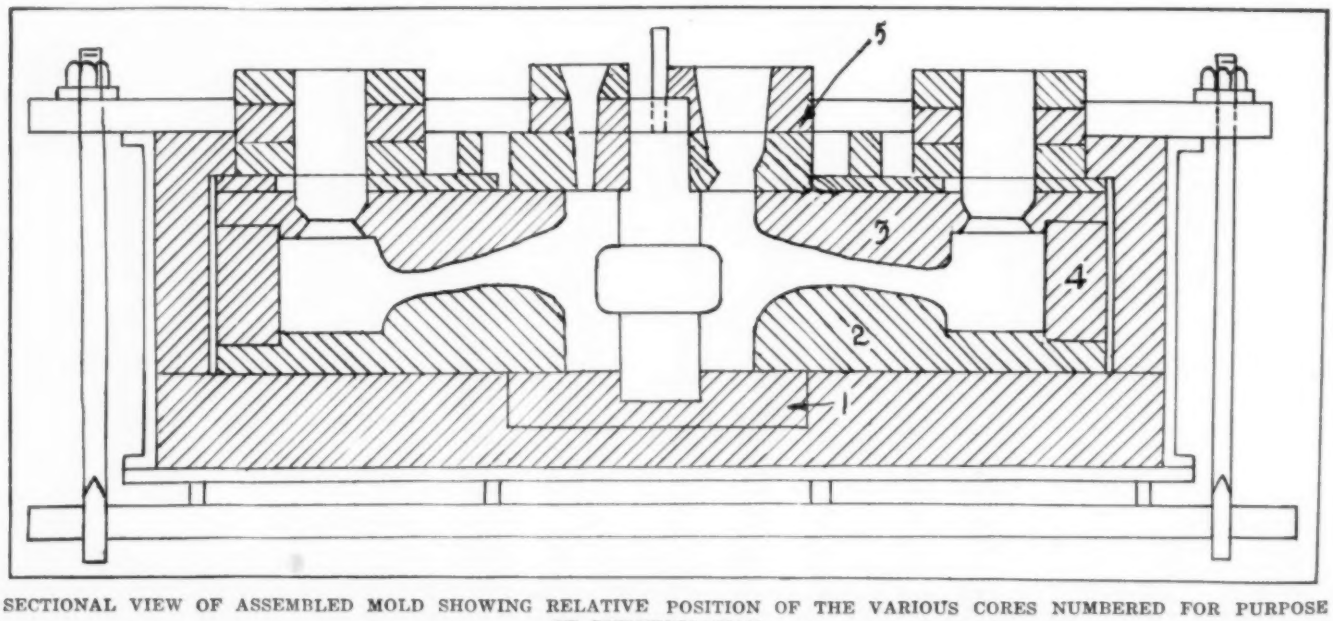
Desires Permanent Molds for Ingot Molds

Question: Do you know of any foundry that has developed a permanent or semi-permanent mold for making ingot mold castings that are used in steel works? Do you think the idea is practicable or worthy of experiment?

Answer: We know of no attempt having been made to cast steel works ingot mold castings in permanent molds. We do not think the idea is practical. If iron molds were used they would affect the density of the metal on the outside of the ingot mold casting. This feature in turn would reduce the elasticity of the mold and shorten its active life. We have not learned of any trials of semi-permanent molds; that is molds with a refractory lining. The idea seems practical, but we doubt if it ever will be developed so long as ingot molds can be made so well, so rapidly and so cheaply by the present universal sand mold process that is used by ingot-mold makers.

American Appraisal Co., Milwaukee, has opened an office at 56 Unter den Linden, Berlin, Germany. This office will be under the direction of L. W. Just.

Charles J. Murray, formerly with the Linde Air roducts Co., has resigned to become connected with the Oklahoma Contracting Co.



SECTIONAL VIEW OF ASSEMBLED MOLD SHOWING RELATIVE POSITION OF THE VARIOUS CORES NUMBERED FOR PURPOSE OF IDENTIFICATION

Market Again Becomes Spotty

While Many Manufacturers Have Secured Heavier Sales in August, Builders in Some Sections, Especially New York, Find Orders Scarce

MARKET for foundry equipment throughout the country is exceptionally spotty, for while a number of dealers are securing a volume of orders far in excess of the totals usually realized during the summer months, other builders are only slightly above the general average for this period of the year. In New England sales of equipment have been exceptionally light during the past two weeks. Inquiry has improved recently and buying is expected to start along more generous lines in September.

No decided slump in the sale of equipment has been reported in Chicago during the summer months, although comparative quiet has been experienced by some makers of equipment. The total business in July about equaled that secured in June and the total for August was in excess of the previous month. Sand preparing and mixing equipment predominates in the sales total in that district. Inquiries are steady.

July was the best month for a long period from the standpoint of sales in the New York territory, but the volume in August has been below normal. One eastern manufacturer of molding machines reports heavy bookings during the past month, including several unusually large single orders. This business is coming chiefly from automotive shops in the Middle West and from plants located in western Pennsylvania. New inquiries for foundry equipment are scarce.

Sales of foundry equipment in July declined 7 per cent compared with June and lost 6 per cent over the corresponding month last year, according to a report of the Foundry Equipment Manufacturers association. The sales in July totaled $378,163 as compared with $407,940 in June and $402,927 in July, 1925. Shipments for the month were valued at $448,390 as compared with $417,632 in June and $372,289 during the corresponding month a year ago. Orders on hand Aug. 1 were valued at $411,119 as compared with $511,290 on July 1 and $457,925 on Aug. 1, 1925.

Exports of foundry and molding equipment showed a further decline in June, according to a report of the department of commerce. The value of exports in June was $45,618 as compared with $51,624 in May.

NEW YORK MARKET

Furnaces

American Brake Shoe & Foundry Co., New York, cupola; from the Whiting Corp., Harvey, Ill.

Ladles

Straight Line Engine Co., Syracuse, N. Y., one 5-ton and one 2500-pound geared ladle; from the Whiting Corp., Harvey, Ill.

Sandblast Equipment

Anglo-Chilean Nitrate Corp., New York, two machines from L. O. Koven & Brother, Inc., Jersey City, N. J., for installation in Chile.

Sand Preparing Equipment

American Abrasive Metals Co., Irvington, N. J.; Flockhart Foundry Co., Newark, N. J.; Fox Hill Foundry Co., Hoboken, N. J.; General Electric Co., Schenectady, N. Y.; M. W. Kellogg, Jersey City, N. J.; Sheridan Iron Works, Champlain, N. Y.; Whitehead Bros. Co., Westfield, N. J.; G. Dikkers, Hengelo, Holland; sand separators and blenders from the Royer Foundry & Machine Co., Wilkes-Barre, Pa.

American Abrasive Metals Co., Irvington, N. J.; sand mixing machinery from the Standard Sand & Machine Co., Cleveland.

Shakeout Equipment

American Abrasive Metals Co., Irvington, N. J., shakeout bail; from the Stoney Foundry Engineering & Equipment Co., Cleveland.

CLEVELAND MARKET

Core Ovens

Packard Motor Car Co., Detroit, continuous conveyor system core ovens from Young Bros Co., Detroit.

Dust Arrester Equipment

Electric Alloys Corp., Elyria, O.; Estate Stove Co., Hamilton, O.; from the Pangborn Corp., Hagerstown, Md.

Sandblast Equipment

Maumee Malleable Castings Co., Toledo; from the Pangborn Corp., Hagerstown, Md.

Sand Preparing Equipment

Ford Motor Co., Detroit, sand mixers from the National Engineering Co., Chicago.

Otis Elevator Co., Buffalo; Bunting Brass & Bronze Co., Toledo; Fremont Foundry Co., Fremont, O.; Kuhns Bros., Dayton, O.; Holmes Foundry Co., Sarnia, Ont.; Lavelle Foundry Co., Anderson, Ind.; sand separators and blenders from the Royer Foundry & Machine Co., Wilkes-Barre, Pa.

Consolidated Iron-Steel Mfg. Co., Cleveland, sand mixer for the Taylor & Boggis Foundry Co., Cleveland; International Malleable Iron Co., Guelph, Ont.; sand mixers; from the Standard Sand & Machine Co., Cleveland.

Shakeout Equipment

Cadillac Motor Car Co., Detroit; Ferro Machine & Foundry Co., Cleveland; shakeout bails from the Stoney Foundry Engineering & Equipment Co., Cleveland.

Humphreys Mfg. Co., Mansfield, O.; shakeout equipment from the Stoney Foundry Engineering & Equipment Co., Cleveland.

PITTSBURGH MARKET

Cranes

Phoenix Iron Works, Phoenixville, Pa., one 20-ton special type; from the Alliance Machine Co., Alliance, O.

Dust Arrester Equipment

Pittsburgh Valve Foundry & Construction Co., Pittsburgh; Pittsburgh Plate Glass Co., Charleroi, Pa.; dust arrester equipment from the Pangborn Corp., Hagerstown, Md.

Furnaces

Chambersburg Engineering Co., Chambersburg, Pa., cupola; from the Whiting Corp., Harvey, Ill.

Ladles

Bethlehem Steel Corp., Bethlehem, Pa., 15-ton; Atlantic Coast Line Ry. Co., Waycross, Ga., one 7-ton; from the Whiting Corp., Harvey, Ill.

Sandblast Equipment

Pittsburgh Valve Foundry & Construction Co., Pittsburgh; Pittsburgh Plate Glass Co., Charleroi, Pa.; from the Pangborn Corp., Hagerstown, Md.

Sand Preparing Equipment

United States Gauge Co., Sellersville, Pa.; separator and blender from the Royer Foundry & Machine Co., Wilkes-Barre, Pa.

Tumbling Barrels

Franklin Valveless Engine Co., Franklin, Pa., one 24x90 inch; Bethlehem Steel Corp., Bethlehem, Pa., one 48x72-inch from the Whiting Corp., Harvey, Ill.

NEW ENGLAND MARKET

Cranes

Ironside Foundry, Ware Mass., one 5-ton electric hoist from the Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.

Furnaces

Wilcox-Crittenden Co., Middletown, Conn., cupola; from the Whiting Corp., Harvey, Ill.

Ladles

Connecticut Foundry Co., Rocky Hill, Conn., three pouring devices from Whitehead Brothers Co., Providence, R. I.

Sandblast Equipment

Manufacturers Foundry Co., Waterbury, Conn., one table from L. O. Koven & Brother, Inc., Jersey City, N. J.

Brown & Sharpe Mfg. Co., Providence, R. I.; Wallaston Foundry Inc., Quincy, Mass.; from the Pangborn Corp., Hagerstown, Md.

Sand Preparing Equipment

Crane Co., Bridgeport, Conn.; sand mixers from the National Engineering Co., Chicago.

Crane Co., Bridgeport, Conn.; Richmond

Wants Information

RICHARD M. LEE, Rockmont, North Strand., Limerick, Ireland, desires information and prices on pattern plates, cupola, molding machines, sand preparation and conveying machinery, core making machines and ovens, sand blast equipment, air compressors and general foundry equipment of standard nature desirable for a foundry producing 60 tons per week of miscellaneous hardware, hollow ware, ornamental, sink and drain, light wheel and sheave castings.

Radiator Co., Norwich, Conn.; Worthington Pump & Machinery Corp., East Cambridge, Mass.; sand separator and blender from the Royer Foundry & Machine Co., Wilkes-Barre, Pa.

CHICAGO MARKET

Dust Arrester Equipment

Lufkin Foundry & Machine Works, Lufkin, Tex.; Electric Steel Foundry, Portland, Oreg.; Willamette Iron & Steel Works, Portland, Oreg; from the Pangborn Corp., Hagerstown, Md.

Ladles

American Magnese Steel Co., Chicago Heights, Ill., 9500-pound ladle from the Whiting Corp., Harvey, Ill.

Sandblast Equipment

Great Northern Railway Co., Hill Yard, Wash.; Electric Steel Foundry, Portland, Oreg.; Willamette Iron & Steel Works, Portland, Oreg.; from the Pangborn Corp., Hagerstown, Md.

Sand Preparing Equipment

Crucible Steel Castings Co., Milwaukee; Southern Wheel Co., St. Louis; Crane Co., Chicago; Terre Haute Malleable & Mfg. Co., Terre Haute, Ind.; Greenlee Bros. & Co., Rockford, Ill.; sand mixers from the National Engineering Co., Chicago.

Crane Co., Chicago; Edwards Valve & Mfg. Co., East Chicago, Ind.; sand separators and blenders from the Royer Foundry & Machine Co., Wilkes-Barre, Pa., through Page & Ludwick, Chicago.

Shakeout Equipment

International Harvester Co., Chicago, shakeout bails; Columbia Sanitary Mfg. Co., Louisville, Ky.; John Deere Tractor Co., Waterloo, Iowa; Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich., shakeout equipment from the Stoney Foundry Engineering & Equipment Co., Cleveland.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

Falls Foundry Co., Cedar Falls, Iowa, is having plans made for an addition 40x96 feet.

Lebanon Steel Foundry, Lebanon, Pa., will rebuild burned portion of its plant recently damaged.

Butler Street Foundry & Iron Co., 3424 Normal avenue, Chicago, is considering plans for rebuilding its burned plant.

Chain Belt Co., Milwaukee, Wis., will add a 1-story foundry and machine shop, 120x308 feet, at Thirty-ninth avenue and Orchard street.

Standard Semi-Steel Foundry Co., 202 East Chase street, Springfield, Mo., has let contract to H. T. Meyer for a forge and platform.

Midwest Foundry Co., 257 South Chambers street, Galesburg, Ill., is rebuilding its 1-story foundry recently burned, 50x50 feet.

Fire recently destroyed the Continental Brass Foundry Co., Chicago. No plans have been made on restarting.

Ludlum Steel Co., Watervliet, N. Y., has changed over its melting furnaces from manual to automatic control.

Atlantic Works, 80 Border street, East Boston, Mass., is having plans made for a machine shop 120x200 feet.

Owatonna Implement Mfg. Co., Owatonna, Minn., is having plans made for rebuilding the burned portion of its foundry.

Fulton Saw Works, Twenty-first place and Fifty-second avenue, Chicago, recently bought by Danly Specialties Inc., will add a foundry to the plant.

A B C Brass Mfg. Co., Cleveland, has been incorporated with $10,000 capital by N. I. Stone, A. Boerder, B. H. Schwartz, R. R. Levenson and J. L. Stetser.

Bids are being taken on a 1-story foundry addition, 60x160 feet, for Chicago Hardware Foundry Co., 549 West Washington street, Chicago.

American Brake Shoe & Foundry Co., Commonwealth building, Pittsburgh, has purchased site for erection of a $500,000 factory at Toledo, O.

Construction will soon start on a 1 and 2-story factory and office building 50x100 feet, for Triangle Tool & Pattern Co., 207 Brady avenue, Detroit.

Racine Malleable & Wrought Iron Co., Racine, Wis., has suspended operations and transferred its current stock to the Eberhard Mfg. Co., Cleveland.

W. S. Tyler Co., Cleveland, Proctor Patterson president, 3615 Superior avenue, has let contract to the Dresser Co., 1082 the Arcade, for its second addition, two stories, 98x105 feet.

Thomas Devlin Mfg. Co., Third street and Lehigh avenue, Burlington, N. J., has let contract to the Austin Co., 1220 Jefferson building, Philadelphia, for a galvanizing building and machine shop 42x100 feet and 51x173 feet.

Parker White-Metal & Machine Co., Erie, Pa., manufacturer of die castings, will build a 3-story structure 45x100 feet to add to its toolroom facilities and will need additional toolroom equipment.

George T. Paraschos Inc., Boston, has been incorporated with 100 shares no par value to manufacture iron and steel castings by Harold W. Cairns, Quincy, Mass., president; Doris C. Kaulbeck and Leslie M. Dill.

Filer & Stowell Co., 219 Becher street, Milwaukee, manufacturer of engines and machinery, has let contract to Worden-Allen Co. for a 1-story machine shop and assembling building and other enlargements.

Spayd Brothers Foundry & Machine Co., Van Wert, O., recently incorporated with $200,000 capital, is building a plant for the manufacture of machinery for the production of barrel staves and barrels.

Chapman Valve Mfg. Co., Springfield, Mass., is building a 2-story electric service and maintenance unit 60x100 feet to supply power for the entire plant and house pattern, steamfitting and other departments.

Ohio Malleable Iron Works, 1325 Euclid avenue, Columbus, O., has had plans drawn for a 1-story addition for fuel handling and storage, equipped with conveying and elevating machinery.

Hall Mfg. Co., Harrison, N. J., John Barto president, 600 William street, is considering plans for rebuilding the burned portion of its plant, including nickel plating and engineering supply departments.

The Specialty Alloys & Castings Co., makers of nonferrous metal castings has opened its plant at 1675 Collamer avenue, Cleveland. William E. Mansfield is president and general manager.

Detroit Lubricator Co., 5842 Trumbull avenue, Detroit, manufacturer of lubricating devices, C. H. Hodges president, will build a 2-story addition 55x110 feet. R. O. Derrick Inc., 120 Madison avenue, is engineer and architect.

Connecticut Malleable Castings Co., New Haven, Conn., has been incorporated with Charles R. Treat, Orange, Mass., president, James A. Walsh, New Haven, vice president, Frank C. Tuttle, New Haven, secretary, and William E. Eccles, West Haven, treasurer.

The New Castle, Pa., foundry of the Stove & Range Co., Pittsburgh, which has been closed down since April, will resume in a few days, according to officials. The resumption will take place as soon as sufficient men are obtained, it was said.

Metropolitan Steel Casting Co., Harrison, N. J., recently incorporated, is establishing a foundry for the production of crucible steel castings up to 350 pounds. A plant is being built. John A. Williams is president and Joseph A. Tedesco secretary and treasurer. (Noted Aug. 15.)

New Trade Publications

STEEL FLOORING—A broadside issued by Irving Iron Works Co., Long Island City, N. Y., discusses its new steel flooring with regard to light diffusion and traction surface.

MEASURING TOOLS—Van Keuren Co., Watertown, Mass., has issued a 16-page catalog of gages, micrometers, and other measuring devices manufactured by the company. Data on machine threads also are given.

ELECTRIC HOISTS—Uses for a light electric hoist around machines are shown in a leaflet issued by Roeper Crane & Hoist Works, Reading, Pa. The hoist is described fully, with speeds and capacities listed.

OIL BURNERS—A line of oil burners for foundry and machine shop work is described in a bulletin published by the McNeat Mfg. Co., Easton, Pa. Numerous uses of the burner are shown and several types illustrated.

COMBINATION TOOL—A folder describing a small, portable, motor-driven combination tool for drilling, polishing, grinding, etc., has been issued by the Stow Mfg. Co., Binghamton, N. Y.

MILLING MACHINES—Two new milling machines are described in a recent bulletin by Kearney & Trecker Corp., Milwaukee. A number of new features is discussed, and the adaptability of the tools is enlarged upon.

POWER PRESSES—Federal Press Co., Elkhart, Ind., has published a circular detailing specifications of its line of open back inclinable power presses, two of which are furnished either plain, geared or combination geared.

WELDING AND CUTTING—The Purox Co., New York, has issued a 64-page catalog of its welding and cutting apparatus, including useful information on oxy-acetylene practice. Several types of cutting and welding torches are described and a section is devoted to supplementary equipment such as pressure gages, valves, etc.